DETROIT
DIVISION OF GRADE SEPARATION AND BRIDGES

REPORT ON GRADE SEPARATION


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Department of Public Works

Report on Grade Separation

in the

City of Detroit

January 1, 1917 to July 1, 1918

PREPARED BY THE

DIVISION OF GRADE SEPARATION AND BRIDGES

Department of Public Works

Report on Grade Separation

in the

City of Detroit.

Report of the Progress of Investigations, Surveys and Construction

for the period

JANUARY 1, 1917 to JULY 1, 1918

PREPARED BY THE

DIVISION *of* GRADE SEPARATION *and* BRIDGES

UNDER THE DIRECTION OF THE

DEPARTMENT *of* PUBLIC WORKS

H. H. Esselstyn,
Commissioner

Clarence W. Hubbell,
City Engineer

John W. Reid,
Engineer of Grade Separation

H. E. Riggs,
Consulting Engineer

PRESS OF
HEITMAN GARAND CO.
DETROIT

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October 15, 1918.

To the Honorable the Common Council:

Gentlemen: I transmit herewith the report of the Division of Grade Separation for the period January 1, 1917, to July 1, 1918, as submitted by John W. Reid, Engineer of Grade Separation, and Henry E. Riggs, Consulting Engineer. This report discusses in considerable detail the real relation of the problem of railway grade elimination to city planning and especially to transportation, of which grade separation is really a very important part. A very large amount of statistical information accompanies the report and with the maps and drawings which are attached, it is by far the most complete discussion of the subject that has ever been submitted to your Honorable Body.

I have felt that it might not be out of place in transmitting the report to give a brief outline of the various topics or chapters and to summarize the recommendations as made by the Division of Grade Separation, all of which I endorse. (See Journal of Common Council, October 15th, 1918, pages 1281-1284, for the summary herein referred to.)

It is believed that the report as presented merits your careful consideration, and it is also believed that the subject is of enough importance and its treatment in the report of such a character as to justify its publication in pamphlet form for general distribution. This is a subject upon which the people of Detroit as a whole should have full information, and it is believed that the information contained in this report will meet that need.

The above report made by John W. Reid and H. E. Riggs, is approved by Clarence W. Hubbell, City Engineer.

Very respectfully submitted,

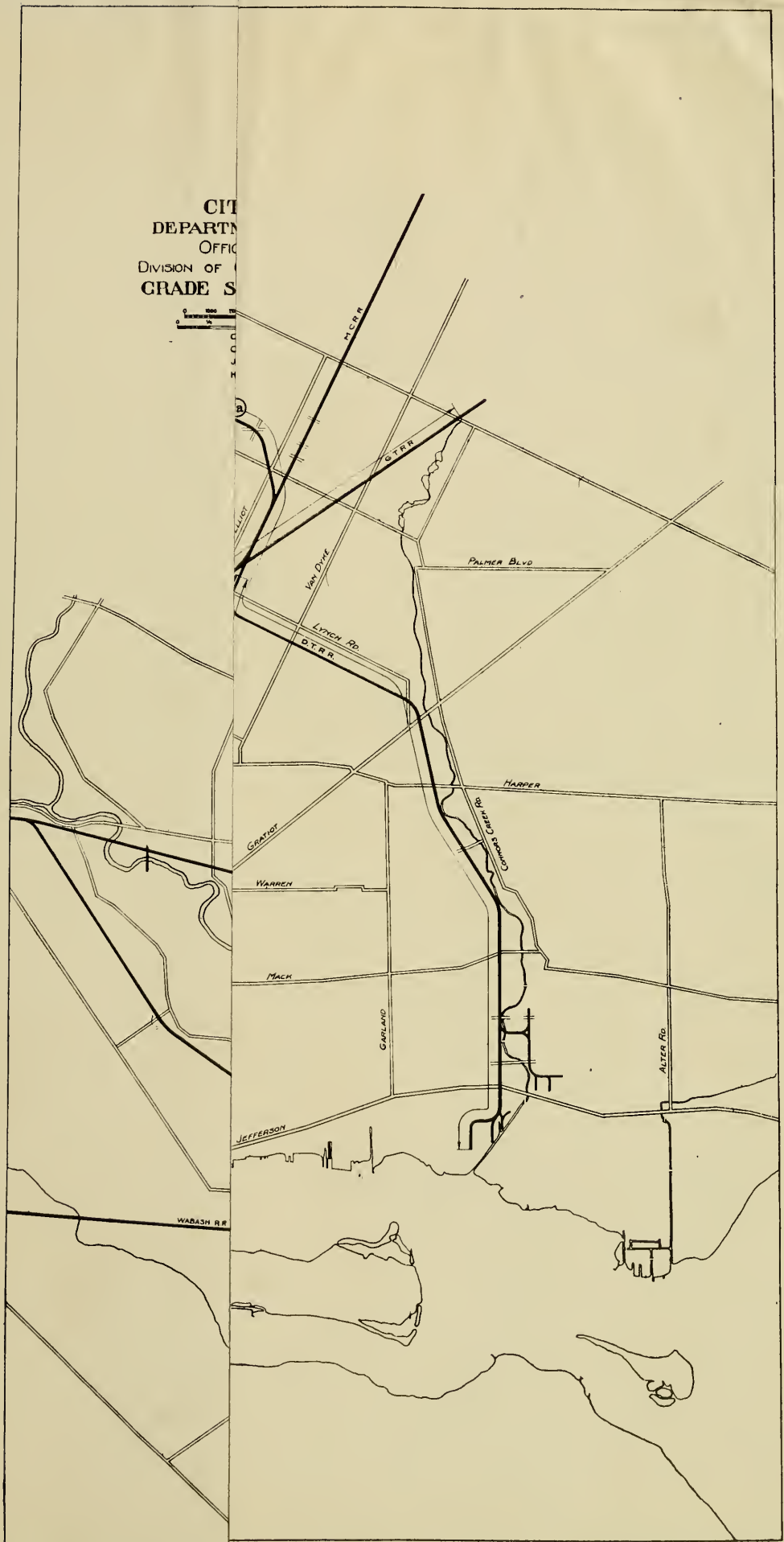
H. H. ESSELSTYN,
Commissioner, Department of Public Works.

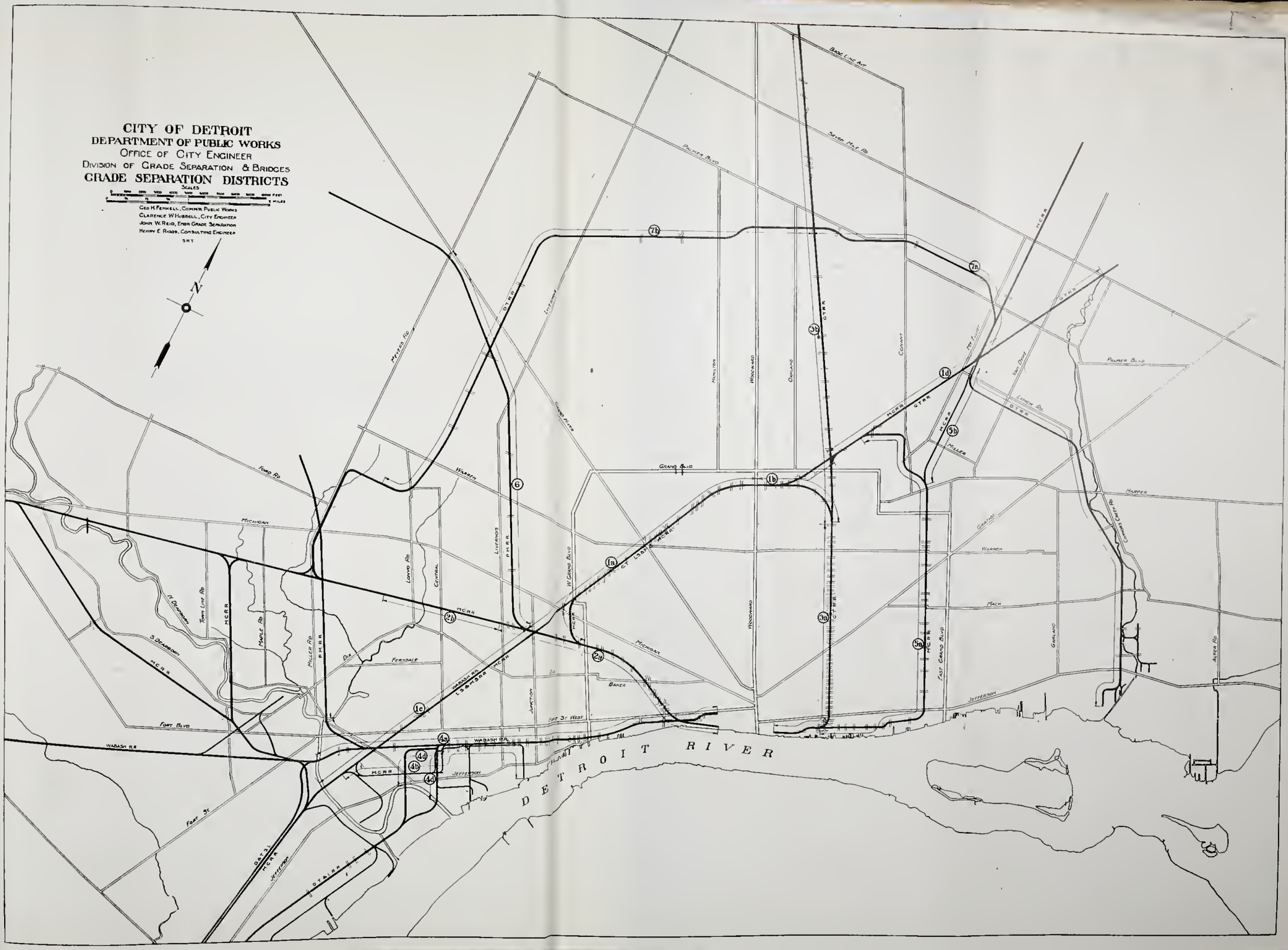
Accepted and referred to Committee on Grade Separation.

By Ald. Glinnan:

Resolved: That the Department of Public Works be and is hereby directed to have the report of the Division of Grade Separation which was submitted to this body October 15th, 1918, printed. Adopted.

Dated, October 28, 1918.


M.C.R.R.
G.T.R.R.
Van Dyke
Palmer Blvd
Lynch Rd.
O.T.R.R.
Harper
Gratiot
Conner Creek Rd.
Warren
Mack
Garland
Alter Rd.
Jefferson
Wabash R.R.


CITY OF DETROIT
DEPARTMENT OF PUBLIC WORKS
OFFICE OF CITY ENGINEER
DIVISION OF GRADE SEPARATION & BRIDGES
GRADE SEPARATION DISTRICTS
SCALES
GEO. H. FERNELL, COMMR. PUBLIC WORKS
CLARENCE W. HUBBELL, CITY ENGINEER
JOHN W. REID, ENGR. GRADE SEPARATION
HENRY E. RIGGS, CONSULTING ENGINEER
SRT
N
DETROIT RIVER
Base Line Ave.
Seven Mile Rd.
Palmer Blvd.
Myers Rd.
Grand River
Road Rd.
Michigan
Warren
Grand Blvd.
W. Grand Blvd.
Fort St. West
Fort Blvd.
Wabash R.R.
Jefferson
Mack
Harper
Alter Rd.
Lynch Rd.
Miller
Baker
Junction
Livernois
Woodward
Oakland
Hamilton
Commit
Van Dyke
Central
Maple Rd.
Miller Rd.
Town Line Rd.
Ferndale
Gratiot
Garland
East Grand Blvd.
MCRR
GTRR
DT&I RR
P.M.R.R.
1a
1b
1c
1d
2a
2b
3a
3b
4a
4b
4c
4d
5a
5b
6
7a
7b

Common Council
Grade Separation Committee

1918

THOMAS E. GLINNAN, Chairman
ALBERT T. ALLAN
JAMES S. HOLDEN
GEORGE W. ROSS
JOHN COWAN
SCOTT HUNTER

Detroit, Sept. 20, 1918.

Mr. Clarence W. Hubbell, City, Engineer,
Detroit, Mich.

Sir:—Upon the establishment of the Division of Grade Separation in January, 1917, instructions were given that a study of the entire problem be made and plans prepared for a comprehensive and general elimination of railroad grade crossings.

Two reports have been submitted to date, each dealing in detail with the specific problems of one district. It is our opinion that before presenting any more plans for the approval of the Common Council, it is desirable that a report be made outlining rather fully the relations of this work to other municipal activities, the scope of the work, the nature of the specific local problems which arise, and submitting a general program for the carrying out of the work.

Furthermore, a good deal of work has been done in the past which is not a matter of public record. Our files contain full or partial information regarding this. These considerations led us to the preparation and presentation of this general report in which we have endeavored to present the History of Grade Separation in Detroit to date, the results of our own studies during the past twenty months, and the conclusions reached by us as to principles and methods which should control future work.

All of this matter should be in the possession of the city authorities; all of it should be made public, as the people of Detroit are vitally concerned in the adoption of proper plans and in their fearless execution.

Very respectfully yours,

JOHN W. REID,
H. E. RIGGS.

Report on the Separation of Street and Railroad Grades in the City of Detroit

I. Grade Separation an Important Phase of City Planning.

In its broadest sense city planning deals with all of the activities of life in a great city; the establishment of industrial, residential and business districts; the opening of proper streets and avenues in and between these districts to provide for the free flow of traffic; the establishment of lines of transportation; the designing and building of parks, playgrounds and boulevards; the restriction and regulation of building activities are among the many things that come within the term "City Planning." It is no part of the scope of this report to indicate what should be done in general city planning work. The separation of grades of streets and railroads is a part of the traffic problem and as such is a mere subdivision of the work of city planning. The work which we have done to date has pointed out a number of matters which are really not part of the work of grade separation but which vitally affect grade separation. Some of these are as follows:

(a) The system of streets in Detroit is rapidly being outgrown. Streets are narrow and in many instances the present cost of widening, taking out of bad offsets or otherwise improving so as to create a fine thoroughfare would be small. It would seem that the new city planning commission might well be charged with the duty of laying out, opening up and improving an adequate and intelligent system of main thoroughfares connecting all parts of the city. We have met the need for such a general plan in every grade separation district. The closing of some streets, opening of some and widening and straightening of others have been recommended by us as part of the solution of the grade crossing problem in these districts.

(b) The establishment of such a plan of main avenues of traffic is not only necessary for the convenience of the present population, but it would give better control over the platting of land and laying out of streets.

The adoption of a plat, which in itself has no patent defects, but which does not properly tie in with surrounding plats, may cause a large future public expense. As illustrating this, attention is called to the condition of plats along the Detroit, Grand Haven and Milwaukee line from the north city limits south to Highland Park. The plats on one side of the right of way bear no relation whatever to those on the other. Streets are not platted to cross the right of way. Present open streets are from half a mile to one mile apart, and a series of dead end pockets will be left between. Where streets can be connected across the right of way bad offsets or angles will be perpetuated.

This condition needs immediate and careful study on the part of some authority. We have hesitated to go further into the matter of planning a general system of thoroughfares than is indicated in this report. We have felt that to do so would be assuming authority and functions not within the field of grade separation. We do not believe we are justified in establishing grades for tracks and providing plans for open streets only. We call attention to this as we desire the co-operation of the proper body in the sections in which we are now making surveys.

II. Grade Separation Is Part of the City's Traffic Problem.

The subject of the elimination of railroad grade crossings has received an increasing amount of attention from American engineers in recent years, as both steam railway and street traffic have rapidly increased. The general rule seems to have been that American railroads were built with but little thought of the possible dangers and interruptions to traffic due to grade crossings. As traffic density increased upon the railroads, and second, third and fourth tracks were added, certain crossings became points of danger and were eliminated. As villages grew into cities and expanded territorially, the need of maintaining a few streets open to traffic at all times, caused both city and railroad officials to seek for some means of grade separation and a considerable amount of the work of elimination has been done in many cities, but in only a few has there been adopted any general comprehensive plan for the complete elimination of all grade crossings. It would appear from a study of existing structures and records that generally the work has been undertaken rather with a view to eliminating crossings because they were a source of danger to human life, or to secure a greater freedom of railroad operation from interruption by traffic on the highway, than as an essential part of a comprehensive plan for bettering city traffic conditions.

Every rapidly growing city faces certain conditions which tend to increase the difficulty of handling its local transportation. Detroit perhaps more than any other city in America, is now face to face with this traffic problem in all of its phases.

(a) The street railway traffic is now perhaps uppermost in the public mind. The need for more cars, more rapid movement of cars, relief of congestion in the down-town section, and additional lines, as well as the possibility of establishing some form of rapid transit, are all matters of public discussion.

The grade separation question is linked to the street railway question in this way. There are 37 points in the city at which single or double track street railway lines cross steam railways at grade, causing delays which, in the aggregate, very seriously interfere with traffic movements to say nothing of the added risk (see Table 1). There are 16 streets at which street railway and steam railway grades are separated.

TABLE I.

Streets crossing the Several Railroads at grade upon which single or double track street railway lines operate.

G. T. R. R. Dequindre	M. C. Belt Line Mfrs.' R. R.	Detroit Terminal R. R.	Pere Marquette (Old Line)	P. M., Wabash, D. T. & I., M. C., Expo. Spur	M. C., N. Y. C., Wabash R. R.	G. T. R. R. M. C. (Bay City)
Catherine	Chene	Jefferson	Michigan	Clark	Dix	Jos. Campau†
Davison	Kercheval	Gratiot	Warren	Dearborn	Fort	Davison
Forest	Mack	Van Dyke		W. Jefferson*		Van Dyke
Fort	Gratiot	Davison		Dearborn**		
Gratiot	Harper	Oakland†				
Lafayette E.	Mt. Elliott	Woodward†				
Milwaukee E.	Lafayette E.	Hamilton†				
Monroe	Jos. Campau†	Lynch				
Sherman		Grand River				

†Within the limits of the villages of Hamtramck or Highland Park.

*Six spur tracks at various points.
**Industrial spur also.

(b) The development of the automobile in the past few years and the tremendous increase in the use of motor driven vehicles has introduced a new element in street traffic. Streets which a few years ago had only a few team movements per day are now traveled by hundreds or thousands of automobiles and teams per day. The increase in number of street movements makes more urgent the abolition of grade crossings, especially when we consider that on many streets there has been a corresponding increase in pedestrian movements.

(c) The great and rapidly increasing area of the city, the larger number of streets and the great surface traffic makes it much more essential that grade elimination be hast-

Sacramento Boulevard, Chicago, Illinois.

Steel Girders—Concrete Facing. The most satisfactory treatment of a street from the standpoint of city traffic.

ened when viewed from the railroad standpoint. More free and rapid movement of trains of all classes within the city and greater safety of operation will justify large expenditures on the part of the railroads.

TABLE II.
Area of Detroit.

Total in 1915			41.76
Annexed in November, 1915	(Greenfield)	3.35	
	(Hamtramck)	1.58	
	(Gratiot)	0.29	
		5.22	
Total after Nov., 1915			46.98
Annexed in Aug., 1916	(Springwells)	1.72	
Annexed in Nov., 1916	(Hamtramck)	7.61	
Annexed in Nov., 1916	(Greenfield)		
13.54 deduct 0.21 (Palmer Park)		13.33	
		22.66	
Total after Nov., 1916			69.64
Annexed in April, 1917	(Gratiot)	5.97	
	(Grosse Pointe)	2.06	
		8.03	
Total after April, 1917			77.67

If we add to this the areas of the Villages of St. Clair Heights and Hamtramck and the City of Highland Park, the areas of which are respectively 0.94, 1.92 and 2.87 square miles, we have a total area within the city boundaries of 83.40 square miles.

Any comprehensive traffic study of the city must indicate certain main thoroughfares which are, and always will be, the principal arteries of travel leading to the outskirts of the city. Connecting with these and tying them together are other streets which are main thoroughfares to certain factory districts or are important connecting links in the street system. All of these must be open at all times to uninterrupted street traffic if Detroit is to properly handle her transportation problem.

The moving of the inhabitants of a city of a million people from homes to work and back again once or twice a day is an immense undertaking. Everything which facilitates that movement bears directly on the problem. For this reason we have considered grade separation as being one phase of the larger subject of city transportation.

III. The General Public, the Manufacturers and the Railroads Are Parties at Interest.

No final adoption of any plan can be made until it has been considered from every possible angle. The interests of the city as a whole, and of the railroad, are or should be, so closely interwoven as to be a mutual interest and both parties should bend every energy to the immediate working out of a complete plan and its rapid execution.

It is undoubtedly the fact that in many cases the feeling has prevailed that the railroad and the city were opposing parties, and it is also the fact that in many instances the railroad interest had been looked upon as the paramount interest and grade separation projects carried out which should not have been built simply because of the desire on the part of railroad managements to avoid large expenditures of railroad money or change of existing conditions of tracks and yards.

There are cases of surrendering public rights in the interest of present economy without regard to future traffic congestion. This would seem to be due rather to a failure to recognize the extent and character of the use of the city's streets than to a deliberate attempt to destroy values. It needs no argument to convince everyone that the great growth of the City of Detroit has been of incalculable financial benefit to the railroads. It is equally true that the City is greatly benefited by the improvement of railroad facilities, and the correct location of freight houses, team tracks, switching and storage yards and industrial connections. Likewise we may argue that both Detroit and the railroads are

interested in the industries, large and small, that are located here. There are in Detroit hundreds of thousands of automobile and team movements, thousands of street car movements, and well over a million pedestrian movements over railroad grade crossings every day in the year. There are hundreds of train movements, through and switching, over these same crossings. Both city and railroad would be benefited by the complete separation not of a few, but of all the streets. The actual carrying out of such separation is complicated by the fact that many hundreds of industries have located along the railroads, have built warehouses or factories and have sidings or industrial connections. Any plan that is adopted must take into account the three interests, and there must needs be occasional concessions to one interest or the other.

Briefly stated—the demands are:

The Public demands an open and safe thoroughfare with sufficient clear head room to permit any usual street or street railway vehicle to pass freely. It must consider the future and not limit, by present day construction, the reasonable future use of the street. The public may very properly protest against going up or down a heavy grade or against narrowing any roadway or against closing any roadway which may in a few years be essential to guard against congestion. The public has a right to demand not only a safe, but a clean, reasonably noiseless, and sightly structure. In view of the fact that the public uses the crossing on important streets tens or hundreds of times to the railroads' once the public interest may be considered the paramount interest, especially if we remember that the railroad is a public transportation utility and that the only reason for the existence of most of the tracks in Detroit is the convenience of that same public which uses the streets.

The Railroad demands good grades—safe head room; the opportunity to run its through trains at high speed, the right to maintain for the benefit of its patrons all such facilities as stations and team tracks; the right to have ample yard facilities for switching, sorting and storing cars, and to have these yards so located that they will meet the requirements of different parts of the city, and further the right to maintain all necessary track connections to industries.

The Owners of Industries must have such connections as will permit the receiving and shipping of freight. They must also have full use of the streets, and freedom from interruption to the movement of teams and employees to and from the industry. The fact that hundreds of industries are now in existence, on tracks at the surface level, that they have built and adjusted their business to those tracks, greatly complicate matters, as a change in level of track, or street, or both, is bound in most cases to cause a readjustment or a reconstruction to fit the new conditions.

While all necessary side and spur track facilities should be afforded industries, the railroads and the city should co-operate in preventing unnecessary duplication of such service.

In most cases the existing arrangement at the manufacturing plant can be used without material change, in some cases a readjustment can be had by elevating the industrial spur and loading platform or by an interior rearrangement, and in still others, more especially very small industries, the cost of the construction to meet any condition that can be considered is such as perhaps to compel a removal of the business to some other location. All of these interests have been considered in the plans so far completed.

The sooner grades are finally agreed upon for every mile of track in the city, the sooner new improvements and extensions to existing industries can be designed to conform to the plan of separation, thereby saving hundreds of thousands or millions of dollars of reconstruction when the actual work of separation of grades is executed.

IV. The Extent of the Grade Separation Problem in Detroit.

Commencing with discussion early in 1900 and the construction of Woodward Avenue subway in 1900-1901, grade elimination work has been in progress more or less continuously, until at the present time elevation of tracks over 43 streets has been completed. The work covered by the several existing agreements, between the city and the railroads, com-

prehended all street car crossings at grade on main thoroughfares except those over tracks of the Grand Trunk (D., G. H. & M.), Michigan Central Belt Line and the Wabash and Pere Marquette railroads.

In addition, 15 streets are carried over railroad tracks, making a total of 58 streets separated. Of these four overhead bridges on the Grand Trunk line will ultimately be replaced by other structures of a different type.

TABLE III.

Streets Carried Over Railroads.

Jefferson at G. T. R. R.	West Jefferson at M. C. R. R.	Vermont at M. C. R. R.
Jefferson at M. C. Belt Line.	Fort at M. C. R. R.	Porter at M. C. R. R.
Congress at G. T. R. R.	Lafayette Boulevard at M. C. R. R.	Fourteenth at M. C. R. R.
Larned at G. T. R. R.	Twelfth at M. C. R. R.	Baker at M. C. R. R.
Grand Boulevard E. at G. T. R. R.	Howard at M. C. R. R.	Fifteenth at M. C. R. R.

This is but a small percentage of the total work. At least five times as many separations must be made. The fact is that the City has grown so fast and added so materially to its area and street mileage that grade crossings have increased much faster than the grade separation work has eliminated grade crossings.

There are in the City today crossings of railroads and streets as follows:

TABLE IV.

Summary of Railroad and Street Crossings.

MAIN LINE CROSSINGS

Dist.	Railroads	Length in Miles	Total Crossings	Crossings Elevated Over Street	Crossings Depressed Under Street	Crossings Under Contract	Crossings Not Under Contract	Streets Closed	Grade Crossings Including Industrial Spurs
1.	Milwaukee Jc. to West Detroit, M. C. R. R., N. Y. C. & G. T. Ry.	5⅓	39	30	..	9	..	..	..
2.	M. C. R. R. Main Line 3rd St. to City Limits...	5	25	11	10	..	2	2	2
3.	Toledo Division, West Detroit to River Rouge, M. C. R. R., N. Y. C.	3¼	12	..	..	10	..	2	..
4.	Union Station to Delray, Union Station Co., P. M., Wabash, Pennsy., D., T. & I. M. C. Exposition Spur Jc. G. T. Ry.	6¾	67	2	..	..	65	..	12
5.	Dequindre St., Brush St. Depot to Milwaukee	3¾	45	..	4	..	41	..	11
6.	Detroit & Milwaukee, Milwaukee Jc. to N. City Limits, G. T. Ry. in Detroit, Highland Pk. and Hamtramck	6	12	..	..	..	11	..	11
7.	Bay City Division, Milwaukee Jc. to N. E. City Limits, M. C. R. R., G. T. Ry., Detroit and Hamtramck	6	8	..	..	..	8	..	..
8.	M. C. Belt Line, Riopelle St. to Bay City Division M. C. R. R.	5	30	..	1	..	29	..	3 N. Jef.
9.	Pere Marquette, West Detroit North to City Limits	5	9	..	..	..	9	..	..
10.	Detroit Terminal R. R., Detroit, Highland Pk. and St. Clair Heights	16	32	..	..	..	32	..	6
11.	Pennsylvania R. R., various lines proposed by the Penna. Co. not yet built	1	4	..	..	..	4	..	..
12.	M. C. and Terminal	1⅓	4	..	..	..	4	..	..
	Totals	64½	289	43	15	20	205	4	34

This summary shows (a) 64½ miles of line, considering all parallel roads as one line. Thus, District 1, 5⅓ miles from end to end, has three parallel main line rights of way, with single or double track, as well as many sidings and spurs. (b) Of 289 streets crossed by main lines only 58 have been separated and 20 more are to be separated under existing elevation agreements. (c) There remain 205 main line crossings and 34 industrial spur crossings yet to be separated.

Grand Trunk Ry.—West Detroit Line, Detroit, Michigan.
East from West of Third Avenue. Side Track on Concrete Trestle.

The figures in Table IV emphasize the fact that progress to date has been slow. Since 1900, when the subject was first taken up, 41 crossings have been built, a rate of less than 3 each year, or considerably less than one mile of line per year has been elevated. At the present rate of progress it will be over fifty years before all of the work is complete. We may very properly conclude without discussion that no such rate can be considered for the future, and in connection with the preparation of plans for a comprehensive system of grade elimination some attempt to determine and agree upon a more reasonable rate of progress will have to be made.

The City of Detroit, located on the north bank of the Detroit River, has grown with a reasonable degree of uniformity to the North, East and West so that it now occupies a territory that is substantially semi-circular. The radius of this semi-circle, was, prior to 1917 annexations of territory, approximately 5½ miles, with the City Hall as a center. The establishment of very large manufacturing plants, in recent years, along the lines of railroad from 4 to 7 miles out from the center of the city, has resulted in the building up of populous industrial centers in various parts of the city, greatly increasing the traffic on streets remote from the down-town business center and especially increasing long distance automobile and street car movements.

As a result of this large development on the outskirts of the City street railway lines have been extended and new lines built which were compelled, temporarily at least, to cross railroads at grade. Other street railway lines have been projected but not built because the Michigan Railway Commission would not permit the crossing of steam roads at grade. The growth of the City has been phenomenal. This growth is well shown by the following table which has been compiled from data furnished by the Detroit Board of Commerce:

TABLE V.

Growth of Detroit in Population and Wealth.

Year	Population	Bank Clearings	Building Contracts	Year	Population	Bank Clearings	Building Contracts
1890	206,000	$ 300,648,010	$ 5,374,480	1910	488,000	910,835,007	17,225,945
1895	245,000	323,528,214	5,338,570	1915	700,000	1,484,972,649	32,235,550
1900	286,000	427,800,392	4,142,400	1916	755,000	2,260,574,784	51,067,110
1905	325,000	597,642,312	10,462,100	1917	900,000	2,749,173,375	39,676,690

In the fifteen years from 1899 to 1914 the value of manufactured products increased from $88,639,945 to $569,519,227, placing Detroit in fourth place instead of sixteenth. There are no official figures for 1915, 1916 and 1917, but careful estimates for these years give $678,000,000, $900,000,000 and $975,000,000 respectively. These figures and many other statistics which might be given, all go to prove beyond any question:

(a) That railroad traffic into and out of Detroit had increased seven or eight hundred per cent in the last 25 years.

(b) That grade crossings constitute a vastly greater source of danger, delay and expense than they did when grade separation was first considered (1900 to 1903).

Unfortunately there is no record of traffic counts on any of the streets at railroad crossings which were separated prior to 1917. It would be of interest and value to compare changes in traffic conditions on Woodward Avenue, for example, in 1900 and in 1917. Certain it is that the continually widening residential areas adjacent to Jefferson Avenue and the erection of such plants as those on this avenue, east of Belle Isle Bridge, have vastly changed the character and number of team, automobile and street railway movements on that street. The same is true of many streets which lead to large residential and industrial centers on the outer edge of the city.

The Street Railway records of car movements and passengers carried for the corresponding period in different years indicates that the increase in car movements has kept pace with the growth indicated in the foregoing pages. The number of cars which passed over railroad grade crossings for the month of June, 1917, gives an idea of the present extent of this traffic.

Woodward Avenue, Detroit, Michigan.

Street width, 74 feet and 100 feet. Roadway, 50 feet (N. Approach, 60 feet). Clearance, 14 feet. Grades, 4%.

TABLE VI.

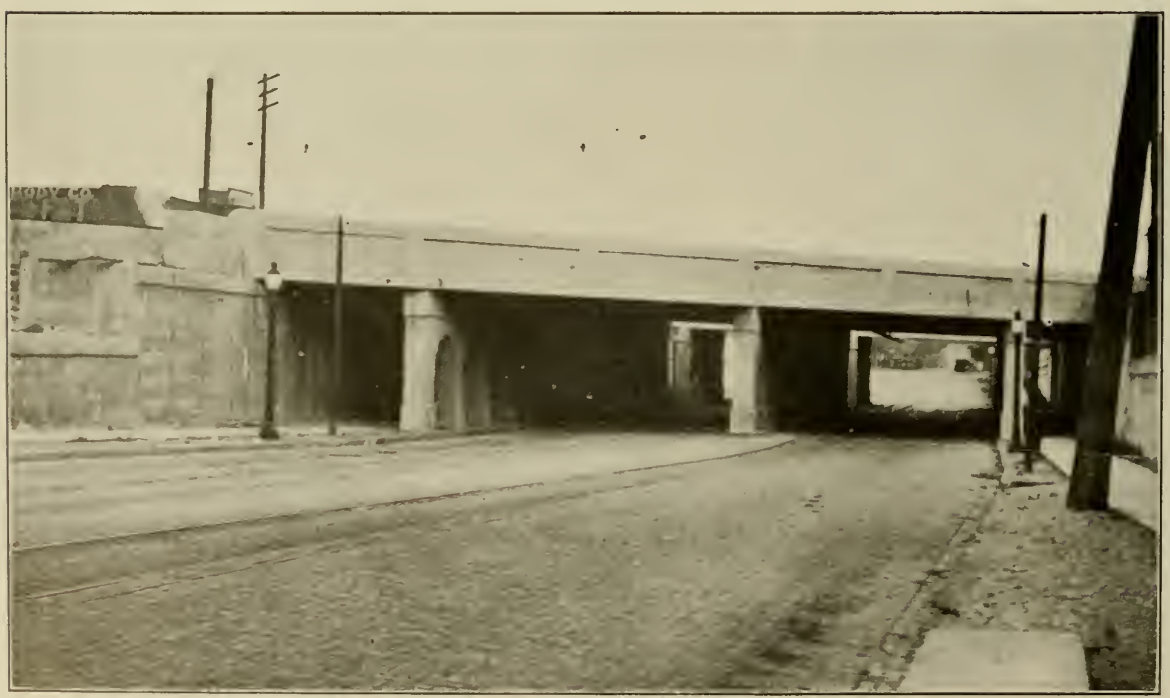
Street Car Movements Over Railroad Grade Crossings.
June, 1917.

St. Car Line	Grand Trunk	M.C.R.R Belt	Wabash P. Marquette	Det., Toledo & Ironton	Detroit Terminal	Misc. Crossings	Total
Baker	818	..	..	..	..	104	922
Crosstown	2,282	1,086	..	..	..	..	3,368
Fourteenth	926	..	..	..	..	..	926
Fort	480	535	639	..	..	1,273	2,927
Grand Belt	1,004	489	515	..	..	..	2,008
Harper	545	721	..	..	..	64	1,330
Jefferson	2	2	..	..	742	..	746
Michigan	1,730	1,987	1,089	..	..	30	4,836
Myrtle	407	..	..	..	..	..	407
Davison-Chene	624	..	..	..	..	337	961
Sherman	628	637	..	..	..	..	1,265
Woodward	25	3	..	..	763	13	804
Dearborn	..	..	..	112	..	398	510
West Jefferson	..	..	..	639	..	..	639
Hamilton	..	..	..	..	348	..	348
Total	9,471	5,460	2,243	751	1,853	2,219	21,997

This indicates over a quarter of a million street car movements per year over lines of road, or probably a million movements or more a year over tracks.

Holden Avenue, Detroit, Michigan.

Street width, 60 feet. Roadway width, 18.25 feet. Clearances, 14 feet and 8 feet. Grades, 3%.



Trumbull Avenue, Detroit, Michigan.

Street width, 80 feet. Roadways width, 25 feet. Clearance, 14 feet. Grades, 3%-3.5%. Double track street railway extended during construction.

V. The Probable Future Growth of Detroit.

In making any plan for a public improvement in a city which has grown as rapidly as Detroit, it is essential that consideration be given to future demands. In this case it may be argued that the streets and railroads being now located the conditions of today fix the problem. This is not true. It is clear that all manufacturing plants of the character and magnitude of the Solvay Company, the Ford plants, Dodge Brothers, Packard, and many other large concerns, which locate in Detroit hereafter, must seek a location well out from the center of the city in order to secure room. Detroit is now adding each year to its population the equivalent of two such cities as Jackson or Kalamazoo. The country road of today, with a traffic of 200 to 300 movements per day over a railroad crossing, may next year be paved, with a street railway extension to a new plant, and traffic increased to between 1000 and 2000 movements per day. The new industry means new business for the railroad and in most cases many additional switching movements per day are made over the crossing, thus increasing the railroad use.

In connection with studies for the Public Lighting Commission, Professor M. E. Cooley, in 1917, made an exhaustive study of the population of Detroit, and made forecasts to 1940. The accompanying chart shows a comparison of estimates of Mr. Cooley with those of the Michigan State Telephone Company, of Mr. C. W. Hubbell in his report on sewers (1916), and of Barclay Parsons and Klapp accompanying the 1917 Street Railway studies. Even if we accept the lowest of these we may expect 1,500,000 population in 1940. Mr. Parsons' analysis indicates a growth to well beyond 2,000,000, but he accepts the latter figure for his estimates.

Mr. Cooley's estimate of 1,827,252 in 1940 is computed at a much less percentage of growth for the next 20-year period than has ever been the case for any 20-year period in Detroit's past history. The past phenomenal growth of Detroit, and the probable future growth, as indicated by these forecasts, have a great bearing on the rate of construction which must be insisted upon. Grade crossing elimination must proceed at a much faster rate in the future than it has in the past. It is fair to assume that but little can be done during the war on account of difficulty of securing materials and labor, and on account of the necessity of deferring all work that can be deferred. The plans should be completed for a comprehensive system at the earliest possible moment and a definite program of construction mapped out which, when executed, will substantially complete the elimination of all grade crossings within the city limits as they existed on January 1st, 1918. The completion of plans at once to the extent at least of determining upon grades of streets and railroads, will enable all owners of property to build with the ultimate grade in view, and to so build as to conform to conditions as they will be. If this had been done twenty years ago much of the present difficulty of adjusting grades to meet present conditions would have been done away with. A 15-year building program means probably 20 years to completion, and by then Detroit will approximate 1½ million population, her area will have extended, more streets will be open and more miles of railroad track built, so that there must not only be a more intensive program initiated, but a continuing program, such a program as may be enlarged and extended to care for these natural increases in area and the necessary new street openings.

VI. Methods of Grade Separation.

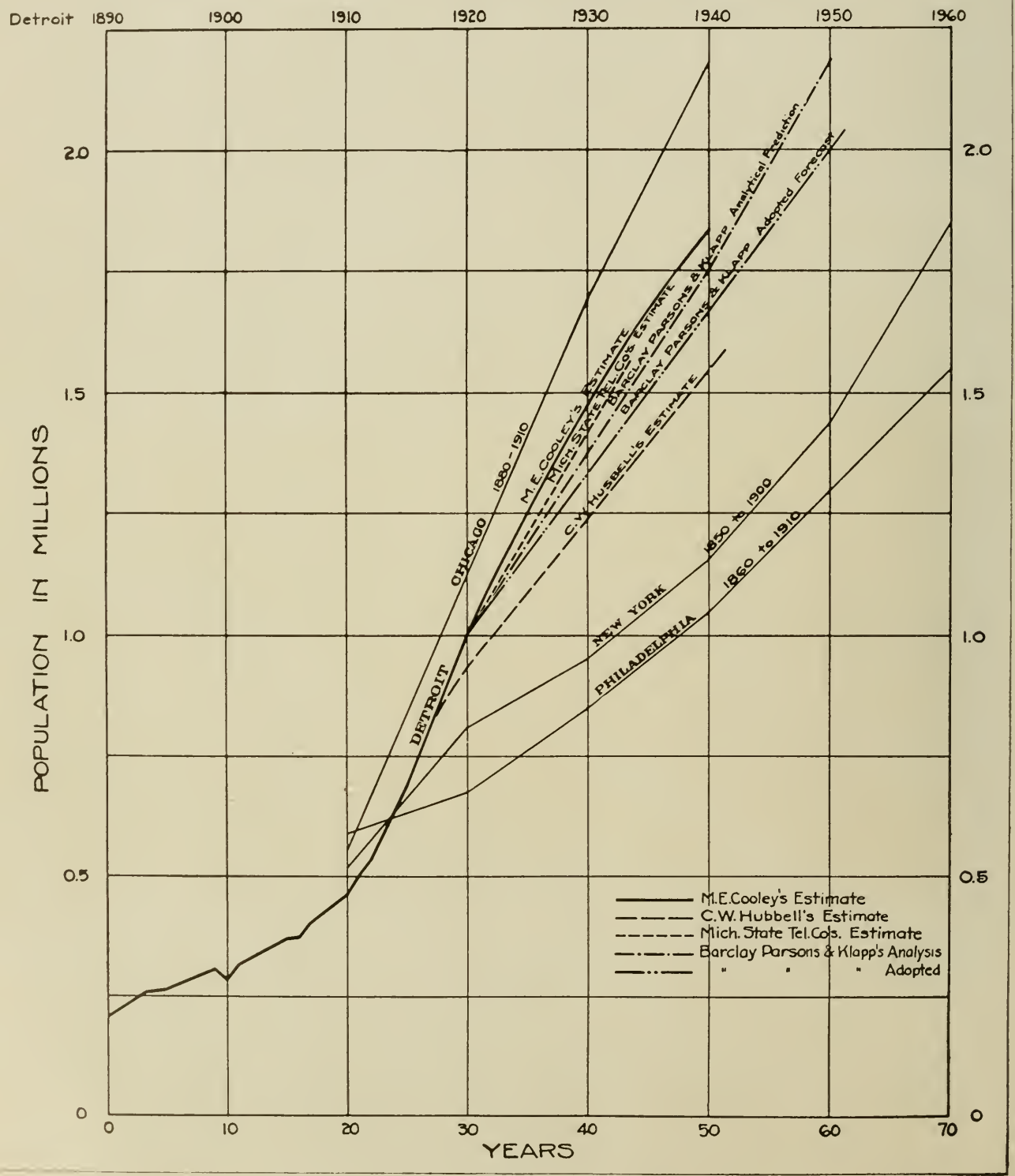
There are three general methods of separating grades of street and railroad which have been adopted.

1. The railroad track is left as it is and the street is either depressed under the track or elevated full height over the track.

2. The street is left as it is and the railroad depressed or elevated to the extent required.

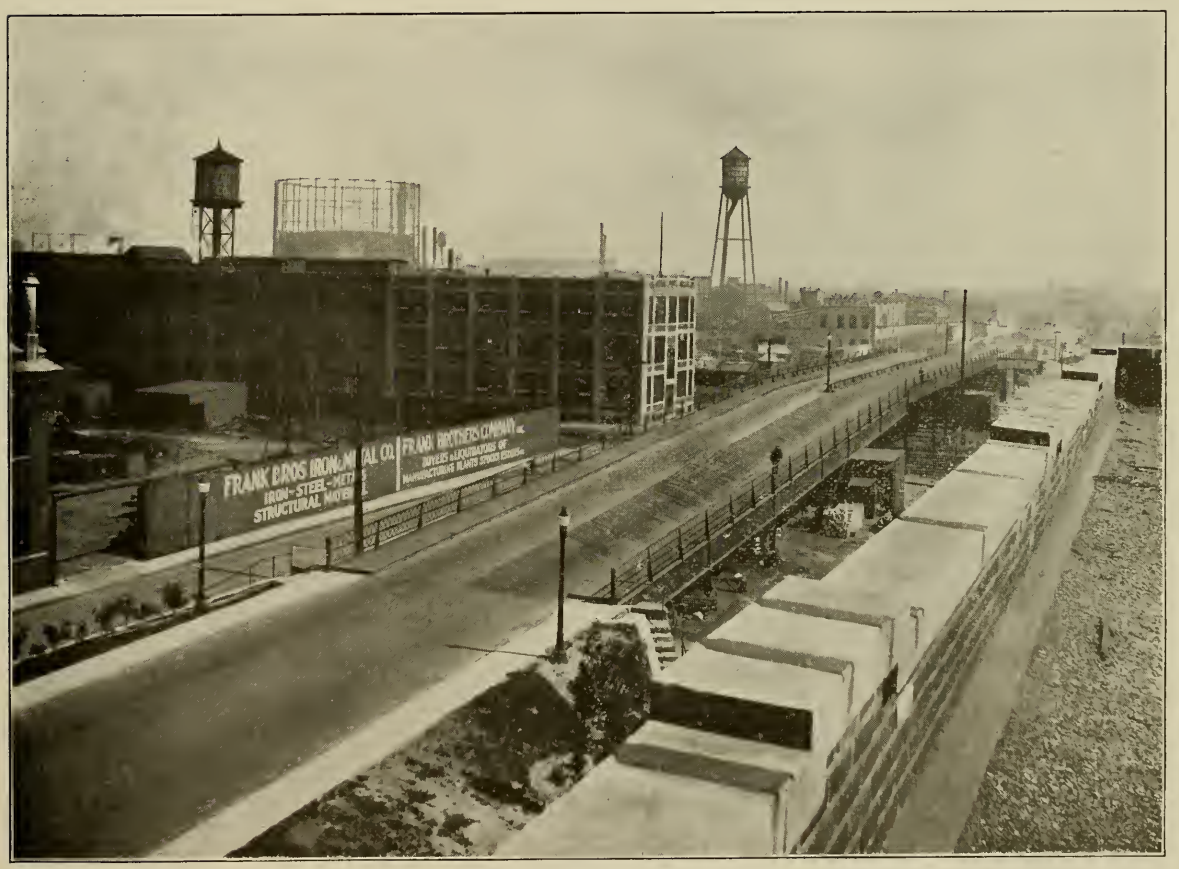
3. Both railroad and street are changed, and such compromises in grade made as best suit the requirements of the particular case.

Predicted Population of Detroit Compared with Actual Growth of Other Cities



The First Method—Changing the Street.

Early work in grade separation has in the main consisted of the separation of one or a few roads or streets in the country or in small cities where the advantages to be derived from a safe crossing overcome any disadvantages due to bad grades or unsightly construction. In nearly all of these cases the railroad has borne all or the larger part of the cost and has not been especially benefited, except as a source of danger from accidents has been removed. Under such conditions the railroad has argued that if the community wishes the grade crossing elimination it must put up with some inconvenience, as the railroad grades could not be changed. An illustration of this condition may be found in the City of Ann Arbor, in which grades on three streets have been separated, the last one having just been opened. In this case the three streets were the only crossings in a distance of two miles. The first one finished has very heavy grades on the street and so fixed conditions that no change could be made in the tracks on the subsequent work.



Viaduct, East Grand Boulevard, Detroit, Michigan.

In general, it may be said that, except in a very few cities, the burden of the change of conditions has fallen on the public, and the belief is more or less general that three should be as little interference as possible with the tracks of the railroad.

Inasmuch as clearances over a railroad should be at least 18 feet in the city, or 22 feet in the country, as argued later, a street or road over a railroad would have to be elevated 21 to 25 feet to provide a proper floor system for a street bridge for which at least 3 feet is required.

Proper clearances over a street being 13 to 15 feet, and four feet being required for a railroad bridge floor system, a depression of the highway involves lowering the surface 17 to 19 feet.

If the elevation of the street be adopted, 700 to 800 feet on each side must be graded for an approach on a grade of 3 feet per 100, thus involving any intersecting streets within that distance and causing heavy property damages. If depression of the street be adopted from 500 to 600 feet of approach must be provided on each side.

Such construction as is suggested above provides for the best type of work. There are hundreds of cases where grade separations have been made with less clearance and with street grades up to 6% and 7%, but they are by no means ideal, and should not be considered at all by the city officials in Detroit. Indeed any attempt to install grade separation projects with improper grades or clearances should be fought to a finish.

Viaduct, East Grand Boulevard, Detroit, Michigan.

The advantages and disadvantages of this method may be summarized as follows:

The advantages, all with the railroad, are (a) undisturbed main track, (b) no change of grades, (c) no changes of yards or industrial connections.

The disadvantages to the city are: (a) enormous property damages, often extending several hundred feet from the railroad and onto side streets which may be involved; (b) serious interference in street depression with the sewers, drains, water pipes and other underground construction; (c) impediment to traffic, due to heavy grades of the streets and the additional rise and fall introduced; (d) injurious effect on the appearance of the street;

(e) industries located on the railroad must provide new outlet, as, if the grade change involves the full width of the street, they are cut off from access to the street.

The City of Detroit has a frontage of 12 miles on the Detroit River. For a distance of 7½ miles there are important railroads along the river bank or close to the river on ground only four to ten feet above high water mark, so that no construction could be carried below the present tracks. The entire area of the city is comparatively level. This would prevent the adoption of any system of depressing of streets below the railroads over at least seventy per cent of the affected crossings on account of proximity to the river drainage or interference with sewers. Any plan involving complete depression of streets may be promptly dismissed as impossible of accomplishment.

Elevation of streets over railroads, the railroads remaining at present grades, is equally not to be considered. The topography of the city does not afford any locations where streets can be carried overhead without the arbitrary introduction of unsightly grades with long approaches. The present viaduct carrying East Grand Boulevard over the tracks of the Grand Trunk Railway has a clearance of 18 ft. 2 inches. This clearance is believed to be proper for grade separation work in cities, but the type of construction of the present bridge would not be adopted and a greater height must be had to provide a proper floor system. To introduce several hundred such structures in the City of Detroit, involving the creation of several hundred hills, obstructing and interfering with the free and proper use of the streets by the general public, would be unthinkable.

There is in Detroit an interesting illustration of the fact that the average driver of a heavily loaded vehicle will not use a viaduct over a railroad if he can get a level road across at grade. The Michigan Central Railroad's Third street yard crosses West Jefferson avenue between Eleventh street and Twelfth street, at grade, with ten or a dozen tracks. Directly overhead is the double track viaduct of the Fort Street Union Depot Company, and on the south side of this and parallel with it is a viaduct carrying a driveway and sidewalks over the tracks of the Michigan Central with a clearance of 17′ 10″. In other words, there is an elevated structure over these tracks immediately alongside of a grade crossing. The grade crossing being lengthwise under a railroad bridge and crossing a dangerous switching yard.

Traffic counts were made in 1917 with the following result:

TABLE VII.

Count of Vehicles and Pedestrians Along West Jefferson Avenue, Detroit, Crossing M. C. R. R. Tracks at Grade and on Viaduct

	Crossing in Hourly Periods										
	9:30	10:30	11:30	12:30	1	2	3	4	5	Total	Per Cent
November 27, 1917—Temperature, 8 a. m., 26°.											
Vehicles Crossing at Grade	42	39	46	..	28	50	68	46	..	319	92.5
Vehicles Over Viaduct	15	3	2	..	4	0	1	1	..	26	7.5
Pedestrians Crossing at Grade	22	30	51	..	23	28	32	34	..	220	96.5
Pedestrians Over Viaduct	4	0	2	..	0	2	0	0	..	8	3.5
November 28, 1917—	9	10	11	12	1	2	3	4	5		
Temperature, 8 a. m., 34°.											
Vehicles Crossing at Grade	50	58	56	..	32	57	40	36	..	329	88.7
Vehicles Over Viaduct	4	9	4	..	8	1	10	6	..	42	11.3
Pedestrians Crossing at Grade	31	23	39	..	28	36	35	38	..	230	97.0
Pedestrians Over Viaduct	1	3	0	..	0	1	0	2	..	7	3.0
December 10, 1917—Temperature, 8 a. m., 2°, snow.											
Vehicles Crossing at Grade	35	39	24	..	38	23	..	..	..	159	97.0
Vehicles Over Viaduct	1	1	0	..	2	1	..	..	..	5	3.0
Pedestrians Crossing at Grade	40	41	30	..	31	17	..	..	..	159	96.4
Pedestrians Over Viaduct	1	0	3	..	0	2	..	..	..	6	3.6
Total Vehicles at Grade										807	91.5
Total Vehicles Over Viaduct										73	8.5
Total Pedestrians at Grade										609	95.1
Total Pedestrians Over Viaduct										21	4.9

West Grand Boulevard, Detroit, Michigan.
Melan Arch. Roadway width, 30 feet. Clearance, 13 feet. Complete depression of the street.

This traffic is largely heavily loaded auto trucks and wagons from factories and wholesale houses to freight houses and railroad yards in the immediate vicinity.

The City of Chicago in first treating the grade separation problem spent several millions of dollars on long and costly viaducts over railroad yards. Finally it was seen that this was futile and a comprehensive plan of track elevation was adopted and is being carried out. This has involved pulling down many of the costly viaducts already constructed. The Chicago Terminal Commission of 1892 says:

> "The topography of the City of Chicago is such that the streets and highways in their natural condition are practically level, and in the exercise of the powers conferred and the duties imposed upon the Common Council, they should be preserved in the same condition to public use, unless there are controlling reasons to the contrary."

The same general conditions of topography prevail in Chicago and in Detroit. In definitely putting aside, as impossible and impracticable the plan of complete elevation or depression of streets and leaving the railroads at present grade, Detroit has not only the arguments which have been advanced, but she has the example of Chicago which adopted the plan and then abandoned it.

In 1908 the City of Toronto petitioned the Canadian Railroad Commission for the elimination of grade crossings along the water front. The railroads in question proposed that the grades be separated by carrying the streets over the tracks by means of viaducts without changing the grades of the tracks. Chief Commissioner Mabee in his opinion, December 30, 1908, says:

> "I am free to confess that when I embarked on this inquiry I thought the erection of bridges the proper solution of the problem, but the more it is thought out, keeping steadily in view the permanent welfare of a large and rapidly growing city, I am driven to the belief that, if bridges are erected this year, ten years hence would see them all torn down."

We have definitely reached the conclusion that this method is not proper in Detroit and should receive no consideration.

The Second Method—Changing the Railroad.

From the standpoint of the hundreds of thousands of citizens who pass back and forth every day on the streets in the course of their business, who are interested in the trucking and hauling of goods from point to point in the city, and who may not come into direct contact with the railroads at all in the course of a year's business, the ideal method is to leave the streets on their present level and move the railroad. The advantages of this method are:

(a) that it leaves the street on the best possible grade,

(b) that it practically or wholly eliminates property damages,

(c) that it creates no interference (in track elevation) with sewers, water mains, conduits or other underground construction.

The disadvantages to the railroad are: (a) introduction of additional grade and rise and fall of 20 to 25 feet at one or both ends of the district; (b) more or less serious interference with industrial connections, in case of small industries sometimes causing removal; (c) necessitates reconstruction of stations and team track yards; (d) may necessitate removal of yards. To the owner of industries there is involved the change of arrangement of plant.

It is the prevailing notion that the cost of changing the grade of the railroad is much in excess of the cost of changing the grade of the street and leaving the railroad at the old level.

This notion is erroneous. It is perfectly clear of course that to elevate a railroad over a single street, or over two or three streets is extremely bad practice regardless of the question of cost, it is equally clear that there are many localities where the cost of elevating the railroad would be in excess of the cost of lowering or raising the streets, but in the average level city, such as Detroit, where the change of grade of a mile of track involves the separation of grades of from eight to sixteen streets there is little difference in cost in the case of the lesser number of streets, and where there are many streets per mile the advantage in cost favors changing the railroad. The reasons for this are obvious. The cost in track elevation is largely in the items of grading, masonry or concrete, and carrying traffic during construction. The same three items with the cost of readjustment of street surface and subsurface structures occur where the street is radically changed and the additional element of damages to property is introduced.

Material for a railroad fill is brought in by train. The cost of steam shovel loading, train haul and unloading will average less than half the cost per yard of the removal of the clay soil in Detroit streets, and its wagon haul to dump scows and dumping will cost. The actual quantities of earth to be moved to fill an **entire 100 foot right-of-way** to a height of 20 feet for 5000 feet is approximately the same as would be moved in lowering 12 sixty foot streets on an equal length of track.

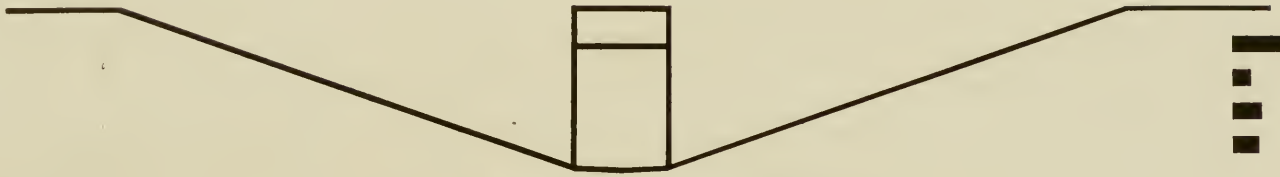
The masonry involved in walls for the railroad fill is of uniform height and standard section, while the street retaining walls, having approximately 10% more masonry are irregular in height and section and consequently more costly per yard.

The permanent bridges and cost of carrying the railroad traffic during construction are substantially equal in either case, and the cost of carrying street traffic where it must be maintained is less in the case of railroad elevation than in case of street depression.

There remains the question of track reconstruction and readjustment of industrial tracks, **which is more than offset by the cost of rebuilding sewers, water mains, pavement, sidewalks and street railway tracks, and the property damages.**

Until one goes into this question fully as your grade separation department has done during the past year, it would not appear to be possible that **full elevation of the railroad**

COMPARATIVE METHODS OF GRADE SEPARATION

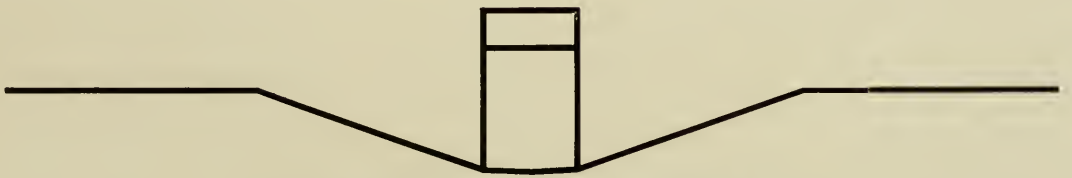


372,200	EXCAVATION
26,600	FILL
41,300	MASONRY
37,800	PAVING

1. TRACKS UNCHANGED

15,400	EXCAVATION
252,000	FILL
43,300	MASONRY
300	PAVING

2 FULL TRACK ELEVATION



125,900	EXCAVATION
136,200	FILL
30,200	MASONRY
21,000	PAVING

3 PARTIAL TRACK ELEVATION

QUANTITIES BASED ON 12 STREETS PER MILE; 60 FT STREETS; 100 FT. RIGHT OF WAY; 13 FT. SUBWAY CLEARANCE; 3.5 PER CENT SUBWAY GRADE

is the cheapest solution, as far as dollars and cents are concerned. Yet while this statement is fairly true for all railroad rights of way 60 to 100 feet wide crossing 8 or 9 streets per mile, it will not hold true;

(a) In cases where there are only a few streets per mile and where the railroads have large yards;

(b) In cases where the elevation of the railroad involves the elevation of a large mileage of connecting industrial spur tracks or extensive rearrangement of many factory buildings.

In 1901 Lewis M. Hastings, city engineer of Cambridge, Mass., made a report on grade separation in which he made estimates on three plans.

Plan.	Physical Cost	Acquisition of Property and Abutting Damage	Total
1. Lower tracks 2 to 2½ ft., raise streets 18½ ft.....	$683,929	$1,398,572	$2,082,501
2. Depress streets 2 to 2½ ft., elevate tracks 14 to 16 ft.....	710,807	97,096	807,903
3. Lower tracks 8 to 8½ ft., elevate streets 12½ ft.....	613,326	791,157	1,404,483

This series of estimates is fairly comparable with the 1917 estimates in Detroit in the Grand Trunk case as illustrating the greatly increased damages due to material changes in the streets.

1. Grand Trunk Plan "N"—streets depressed 7 to 10 ft., tracks elevated 7 to 10 ft.....	$6,436,947	$1,839,000	$8,275,947
2. City Plan—7,000 ft. of Grand Trunk track depressed 21 ft., street level	5,379,671*	1,300,000	6,679,671
3. Grand Trunk Plan "O"—7,000 ft. Grand Trunk track elevated 18 to 21 ft.; streets level to 5 ft. depression.....	6,034,916	700,000	6,734,916

*This includes an item of $149,864 for viaducts at Hale and Scott streets, if they are to be built.

These estimates were agreed upon by engineers of the Grand Trunk Railway and the Division of Grade Separation of the City of Detroit.

The foregoing discussion leads us to the conclusion that from the standpoint of most ideal conditions for the city the full elevation of the railroad tracks is the proper thing, that cost of construction is not only not against this method but in the City of Detroit this is the cheapest solution, that inasmuch as the main tracks are elevated for their entire length in the city there is no objection to be urged on account of grade, and that the only reasons that would cause local modification of the plan are:

1. The inability of existing manufacturing plants to adjust themselves to an elevation of 18 or 19 feet, which is likely to occur only in exceptional cases.

2. Difficulties of securing proper team tracks.

These conditions require compromise in such districts as are thickly built with industrial plants or yards.

The Third Method—Grade of both Street and Railroad are Changed.

This plan has been adopted in the case of all "Track elevation," so-called, completed or under contract, to date, in Detroit. The tracks have been elevated from 6 to 10 feet. The streets have been lowered from 6 to 14 feet.

While full record of the discussion leading up to the adoption of plans already carried out has never been kept, it is known that the comparatively slight elevation of the railroad tracks was due in large measure to the fear on the part of the owners of industries that greater elevation would seriously harm them, and probably also to the belief that the cost of greater elevation would be excessive.

We recognize the fact that it is to the best interests of all three parties to make such adjustments as are really for the greatest good, hence no hard and fast rule can be adopted which is equally applicable under all conditions.

The work already done in Detroit, although a vast improvement over original conditions, is far from ideal. In future work all manifest mistakes should be corrected. In general, the following modifications of plan are suggested:

1. The general elevation of the railroad should be much more than on the old work. As has been indicated the total cost is no more for a 15 to 17 foot elevation than for a 6 to 8 foot elevation. The adjustment of tracks in industrial plants may be more expensive but a re-adjustment is necessary in either case, and if the track be fairly long and grounds ample, an adjustment can be had to a 17 foot raise without any difficulty. Very often in close quarters loading and unloading can be handled from platforms on the second floor level. The interest of the public at large, the City of Detroit, with its close to million people, the rights of that public to use the streets freely, and not to be compelled to go up-hill or down-hill forever is clearly such an overwhelmingly large interest that it must dominate in fixing grades of the main traffic streets. Local needs may call for compromise, but any compromise or modification of the ideal plan may be restricted to districts in the city which are of a distinctly industrial character.

In view of these facts we would recommend:

(a) That on all main arteries of travel, such as Woodward, Jefferson, Michigan, Gratiot, Grand River, Mack, Boulevard, and manyother streets, to be determined by Council, the maximum allowable depression of the street should not exceed two to three feet and the maximum grade on the street should not exceed two and one-half per cent.

(b) That on other important and well traveled streets the maximum grade of 3% should be held and no depression of over five feet in the street should be approved.

(c) In purely industrial districts, especially where the streets carry no large volume of through traffic, and local conditions make it necessary, considerably greater concessions as to depth of cut may be made, but in no case should grades of the street exceed 3½ to 4%.

2. The subject of clearance is of greatest importance and deserves special attention on account of the necessity of adopting standard clearances. Street clearances on existing grade separations range from 10 to 14 feet.

TABLE VIII.

Minimum Clearances Over Streets.

	Clearances over Street. No St. Ry.	Clearance over St. Ry. Track
Buffalo	13	14
Boston	13	16½
Chicago	12	13½
Cleveland	13	14½
Detroit	10–12–13	14
Elizabeth, N. J.	11	13
Indianapolis, Ind.	11	14 City Car Lines 15′ 9″ Interurban Lines
Kansas City	13	14½
Milwaukee	12	13½
New York City	11–14	14–16
New York City Elevated Lines	14	
Chicago Elevated Lines		14–16
Philadelphia Elevated Lines		14
Newark, N. J.	12½	15′ 6″
Toronto (order of R. R. Com. Dec. 24, 1908)	14	14
Worcester, Mass.	13	14–15

Wabash Avenue, Detroit, Michigan.

Street width, 65 feet. Roadway width, 26 feet. Clearance, 13 feet. Grades, 3%.

Kirby Avenue, Detroit, Michigan.

Street width, 60 feet. Roadway width, 30 feet. Clearance, 13 feet. Grades, 3%-3.38%.

In general clearances of 13 and 14 feet on streets without car lines is ample. Detroit has, in the past, adopted 14 feet for clearances on all streets carrying car lines. This is ample for city street cars of old type but cars are now operating in Detroit which barely clear the 14 feet, and as modern types of electric railway equipment tend to a greater height and many types will not pass a bridge of 14 feet clearance a clearance of 15 feet has been provided for on the work covered by the agreement of September 26, 1917, and has been contended for at the Grand Trunk-Dequindre street crossings and provided for on the plans for the separation of the Fort Street Union Depot companies lines. It is recommended that a clearance of 15 feet be provided at all street railway tracks and on all streets of such character as possibly may some day have street railway lines. The City of Detroit should not place a limit on its right to demand the most modern and up to date equipment.

While we favor maximum elevation of the steam railroads, and minimum interference with the streets, we do not believe that we are justified in assuming the position that such treatment is proper throughout the city.

We would prefer to recommend the adoption of such a program as will give wide latitude, providing for—

(a) Nearly complete elevation over important streets.

(b) Compromise elevation at such points as the needs of permanent industries or the consideration of team tracks or other public facilities of the railroads demand.

(c) Moderate elevation or no elevation in such industrial districts as are on one side of through traffic.

Such a program would really mean—

A. Giving prior consideration to the streets on all through thoroughfares.

B. The complete elimination of all railroad main line grade crossings thus permitting free and fast passage of trains within the city area.

C. Maximum concession to the industries wherever such concession does not perpetuate bad conditions in streets which are, or may become, well used thoroughfares.

Elevation or Depression of Railroads.

It has been indicated that we favor in general elevation rather than depression of the railroads. In fact the topography of the city would absolutely forbid the depression of some of the lines, and sewer and water main complications would prevent or make the depression of tracks on most of the lines a very expensive matter. The main line of the Michigan Central Railroad between the old Third Street Depot and the new M. C. R. R. station at Fifteenth street passes under all streets. The clearances above the top of rail are very small. Five bridges have less than 16 feet, two have 16′ 2″, at Vermont street there is a clearance of 17′ 8″, and the Pere Marquette and Wabash and West Jefferson viaduct have 17′ 10″ clearance. Several of these bridges have been in place many years and the surrounding territory is fully adjusted to the condition. It is extremely doubtful if the Michigan Railroad Commission would approve any such clearances today. General practice in the United States clearly leans to the adoption of a clearance of 18 feet, or somewhat less, in large cities where the enormous expense attendant on securing a greater head-room is a great factor.

Supporting the above statement, the following facts are cited:

The Michigan Central Tunnel at Detroit has a clearance of 18 feet. All bridges over the tracks of the New Union Depot at Chicago, now being built at a cost of about forty million dollars, have a clearance of only 16 feet 6 inches.

In the City of Chicago there are 70 overhead bridges limiting the clearance on twelve railroads to less than 16 ft. 6 inches, as shown in the following table:

Complete Depression, H. & D. Division, C. M. & St. P. R. R.
Minneapolis, Minn. Clearance 18′.

TABLE IX.

Minimum Clearances in the City of Chicago.

Railroad	No. of Bridges	Clearance
Atchison, Topeka & Santa Fe	3	16 ft. 5″ and less
Baltimore & Ohio, Chicago Terminal	6	16 ft. 4″ or less
Chicago & Alton	2	15 ft. 9″ or less
Chicago & Northwestern	14	16 ft. 4″ or less
Chicago & Western Indiana	3	16 ft. 5″ or less
Chicago, Burlington & Quincy	4	15 ft. 7″ or less
Chicago Junction R. R.	14	16 ft. 5″ or less
Chicago, Milwaukee & St. Paul	4	16 ft. or less
Grand Trunk Western	1	16 ft. 5″
Pennsylvania Lines (P. C. C. & St. L.)	7	16 ft. 2″ or less
Pennsylvania Lines (P. F. W. & C.)	11	16 ft. 2″ or less
Illinois Central	1	16 ft. 4″

Nor is this true of Chicago and Detroit alone. Information furnished us by the Chief Engineer of the Boston and Albany shows clearances of structures over that line as follows:

City	No. of Bridges	Maximum Clearance	Minimum Clearance
Boston, Main Line	16	16.53 ft.	14.92 ft.
Grand Junction Branch	8	17.04 ft.	15.45 ft.
Newton, Main Line	20	18.33 ft.	14.94 ft.
Highland Circuit	9	18.17 ft.	16.08 ft.
	1	20.25 ft.	15.73 ft.
Natick	6	16.50 ft.	.....
Highland Circuit, Brookline	12	18.42 ft.	15.00 ft.
Framington	2	17.96 ft.	17.85 ft.
Worcester	7	18.33 ft.	17.60 ft.
Springfield (2 under 18 ft.)	3	19.65 ft.	17.78 ft.
Pittsfield	6	18.50 ft.	16.75 ft.
"	2	22.00 ft.	
Chatham	3	17.50 ft.	16.60 ft.

Total, 95 bridges, four of which are over 18½ feet.

In the City of Philadelphia:	No. Bridges over 19 ft. clearance	No. Bridges 19 ft. or less clearance
Pennsylvania Lines	14	29
Philadelphia & Reading	14	30
Baltimore & Ohio	..	5
In the City of Buffalo	5	31

In view of the fact that depression of track, if used at all in Detroit, could be recommended only on the Grand Trunk lines between Jefferson avenue and Hale street, the investigation of overhead clearances has been carried no further than was done in the early weeks of 1917.

In our report of February 28th, 1917 (Journal Common Council, pages 333-353) relative to the Grand Trunk Dequindre street grade separation (District 5) we recommended track depression in this district for the reasons—

(a) That the tracks now pass under three important streets.

(b) That no sewers or important water mains were involved.

(c) That depression gave, in our opinion, better grades in the main railroad yard.

(d) That it was a much better solution for all streets from the standpoint of the city.

(e) That the plan proposed by the railroad would ruin Jefferson avenue.

(f) That the cost would, in our opinion, be much less.

This particular stretch of track, after passing under Jefferson avenue, Congress street and Larned street rises on a 1% grade over 50 feet and it is possible to get equally good grades and good drainage by either elevation or depression. The Michigan Central Belt also passes under Jefferson avenue but the first street north (Lafayette street) blocks either a depression of railroad or street over five feet on account of a large sewer and the impossibility of getting drainage.

In general, the arguments for and against the depression of railroad tracks may be summed up as follows:

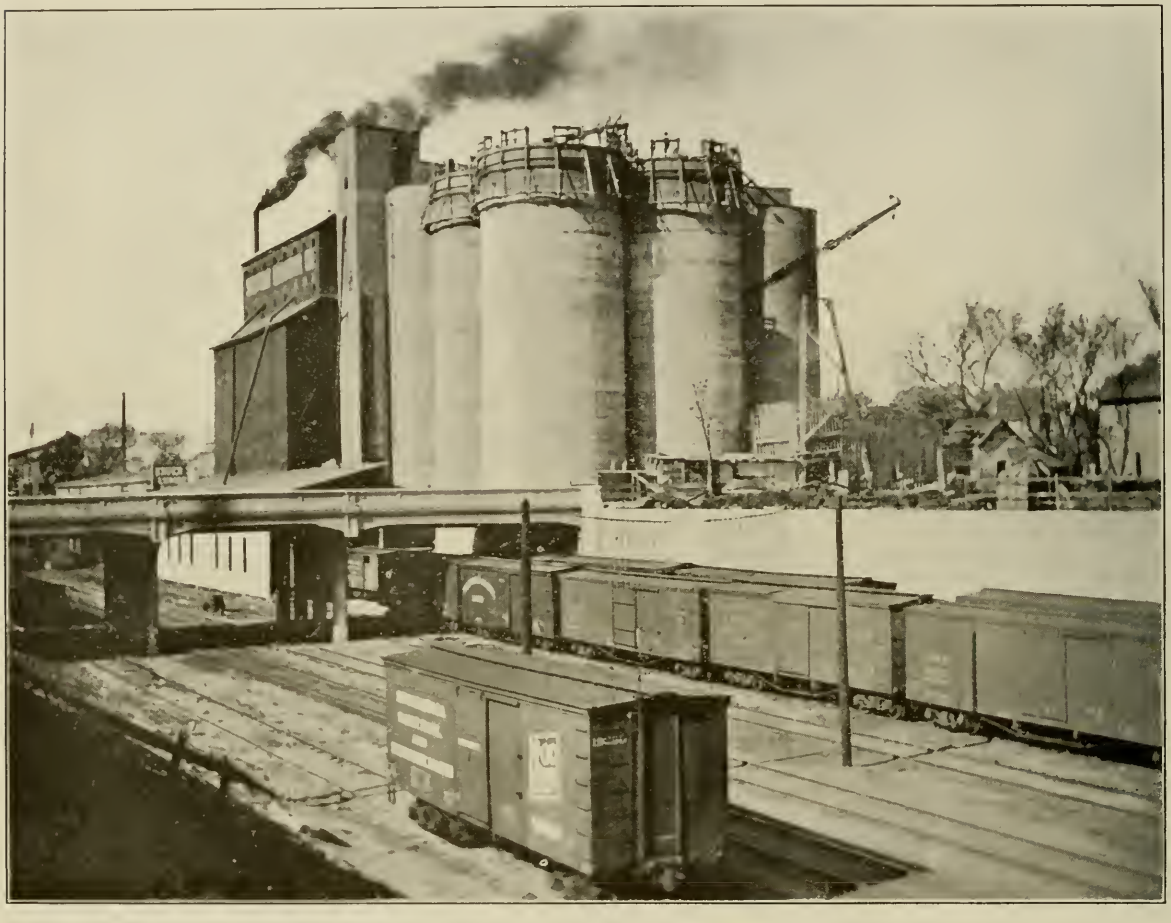
The depression of the railroad leaves the street free from any overhead obstructions, new crossings can be built with less interference with traffic, complete depression hides the railroad from view and from an aesthetic standpoint is most satisfactory. On the other hand, the general arguments are that there is greater difficulty in constructing the subway, the cost is added to largely on account of great changes in underground sewers and conduits, drainage is more difficult to secure, there is greater interference with railway operation on account of snow in winter, the smoke nuisance is greater to the railroad in an out than on elevated track and it is much more easy to adjust industries to elevation than to depression. This particular section of Grand Trunk track is an exceptional case as there are no large industries, and no complications due to sewers, water or other underground conduits, the road having been built some sixty years ago. In this case the railroad strenuously contended for elevation and conceded much more complete track elevation than has heretofore been built in Detroit.

Upon the whole, it must be conceded that the arguments in favor of railroad elevation as against railroad depression are sound and that in Detroit there can be but little consideration given to anything but an elevation plan for the railroads, with the one exception.

While we have no such strong objections to the plan known as Grand Trunk "Plan O," as we had to "Plan N," we still are of the opinion that this section of track, in the very heart of the city, should be depressed, but we favor the adoption in general, of track elevation.

Complete Depression—H. & D. Division, C. M. & St. P. R. R.
Minneapolis, Minn. Clearance, 18 feet. Main Line and Industrial Siding.

We favor maximum elevation so far as it is practicable to attain it, but recognize that there are local conditions where the interests of the railroad or the interests of industries may demand a radical modification of the plan.



Complete Depression—H. & D. Division, C. M. & St. P. R. R.
Minneapolis, Minn. Clearance, 18 feet. Main Line and Industrial Siding.

VII. Types of Construction.

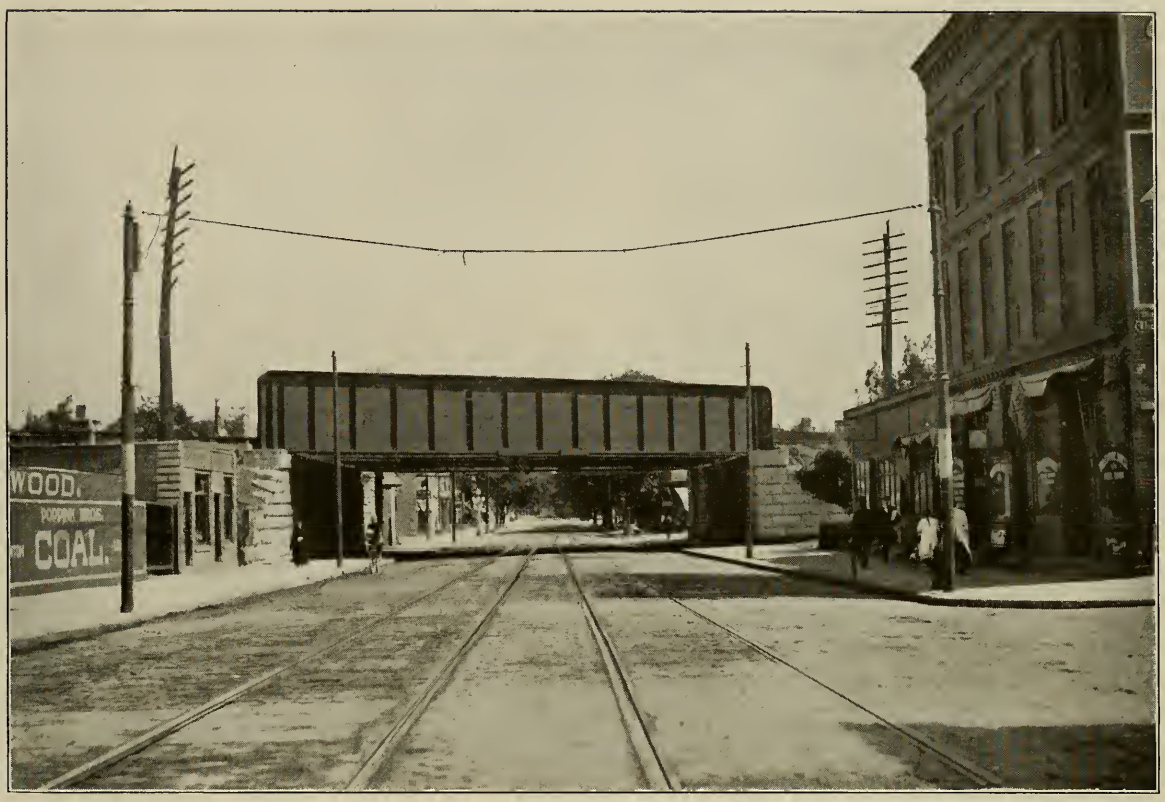
In view of the general excellent character of construction work that has been done in Detroit in recent years, there is little room for dispute between the City and the railways as to materials of construction or general plans.

The earlier types of bridges used in other cities, unsightly steel girders, open floor systems, with noise, dirt, water dripping into the subway and other objectionable features, have never been considered in the work done here in recent years.

The use of concrete structures, properly water-proofed, with ballast floors, has been adopted, and has given such general satisfaction that there can be no question as to the propriety of its continued use.

Width of Bridges.

With comparatively few exceptions the streets of Detroit are narrow; 50 foot, 60 foot, 72 foot and 80 foot streets represent by far the greater perecentage of the projects that are yet to be carried out. In view of the extremely heavy traffic now carried on many streets, and the certainty that traffic on streets not now paved will be greatly increased as the



North Street, Rochester, New York.
Unsightly structure due to insisting on clear span over street.

streets are improved it is certain that no narrowing of roadways can be considered. The use of posts in streets of 50 foot width or less is objectionable on account of obstruction to the street, and cutting off of light. In streets of greater width, or where the railroad makes a bad skew angle with the street, a type of structure with posts on the curb lines is essential to save excessive elevation of the track, while in a few cases of very wide streets it may be necessary to permit one row of posts in the middle of the street. This should not be considered in any streets where the width between curb lines is less than 60 feet. There are cases where, on account of head room clearance, it may be advisable in the case of driveways to factories, or of streets which serve only one or two industries and are not in any sense thoroughfares, to permit much shorter spans.

In general we would recommend that plans be adopted along the following lines:

(a) Streets of 50 feet or less, where the crossing is substantially a right angle, a clear span without posts.

(b) Streets over 50 feet or streets on a skew, clear span curb to curb, posts clear of the curb lines.

(c) Extremely wide streets or streets on a bad skew angle, four spans may be permitted and the special type of construction adopted to meet the special conditions shall be approved by the city. Wherever possible driveways shall not be less than 30 feet, measured at right angles to the center line of the street.

(d) In no case shall abutments for bridges be built within the limits of the street.

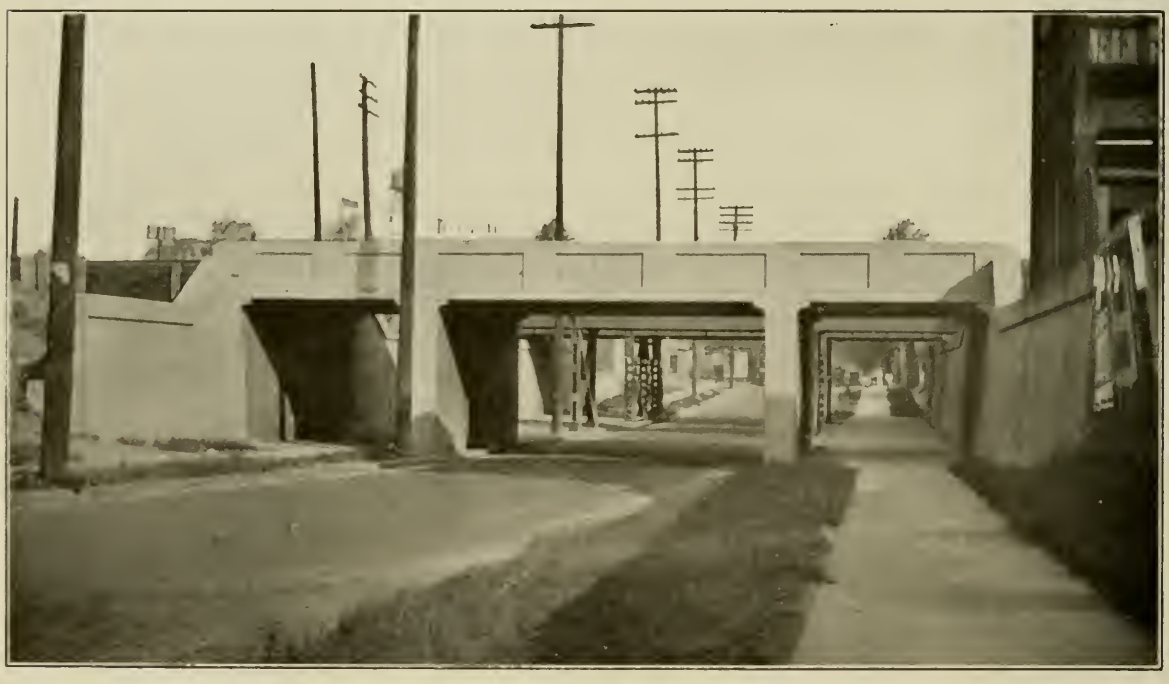
(e) Exceptional cases of short streets or driveways to factories may be given individual treatment.

Arch or Flat Slab Design.

The majority of cities have favored the use of the stone, concrete or brick arch, rather than a structure with straight lines. That there are many arguments in favor of the use of arches in such locations as fine residential sections of the city, parks, boulevards and in locations where the topography admits of ample head room there can be no question. The problem here is rather to secure a structure with minimum height to provide the necessary clearance, of maximum width, noiseless as possible, and of good sightly design, than to seek for purely aesthetic effects.

The use of the arch reduces headroom on the sides of the street, and tends to materially lessen the light under the structure. Present day methods of concrete construction insure that with proper specifications a durable and pleasing surface can be secured, and fine artistic effect can be had by the use of good lines and proper finish of materials.

Much thought has been given to questions of design, and it is our conclusion that for a general standard of construction the concrete bridge with simple straight lines, will be far more satisfactory than the arch in nearly all locations and will be subject to such artistic treatment in the way of balustrades or coping as will best conform to the surroundings.

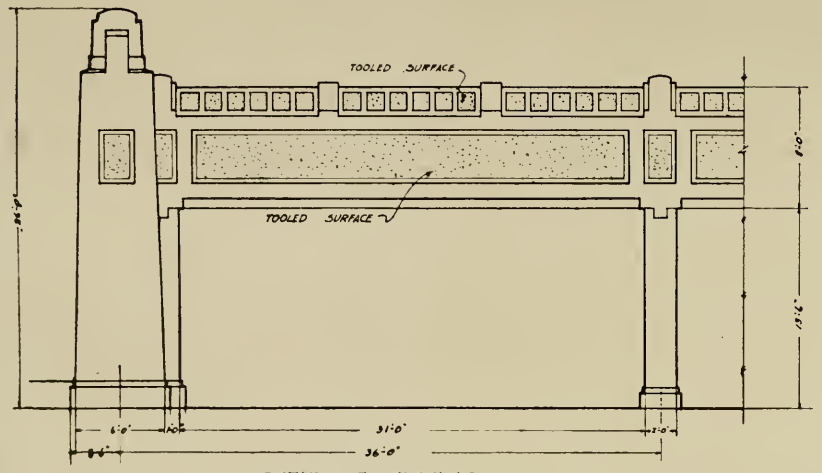


John R. Street, Detroit, Michigan.
Street width, 60 feet. Clearance, 12 feet. Roadway width, 26 feet. Grades, 3%.
First of the reinforced concrete type.

The great advantages of this type are uniformity of the general design, ease and rapidity of construction, moderate cost, strength and permanence.

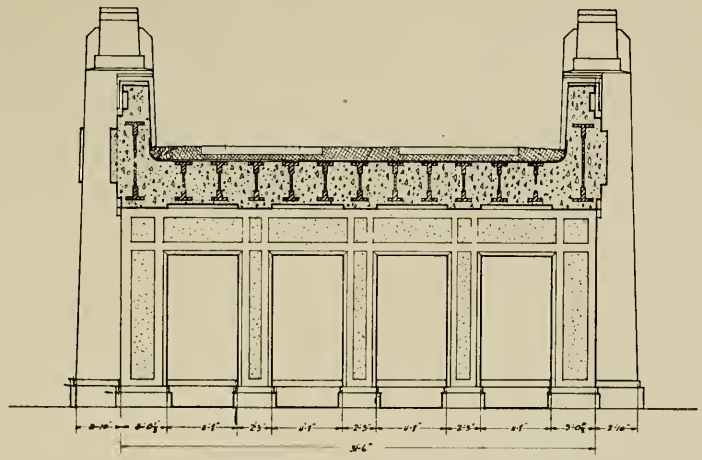
The general plans submitted herewith, and the photographs of existing structures of the type, indicate clearly the kind of construction that appeal to us.

The general effect of any improvement will be very greatly enhanced if part of the money which would be expended to secure an arch of doubtful architectural worth, be expended in correcting defects in street grades, providing longer approaches, proper lighting of the subway and proper retaining walls along the street. Where the conditions will permit the ground should be sloped to meet the new grade and retaining walls omitted.



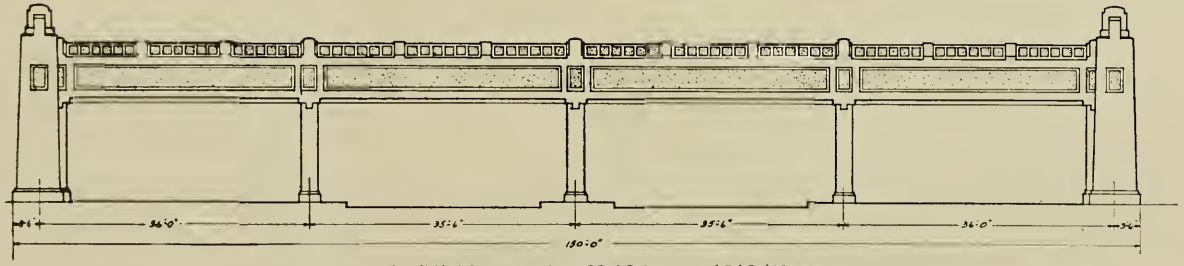
DETAIL OF ELEVATION

SCALE 1/4" = 1'-0"



TRANSVERSE SECTION

SCALE 1/4" = 1'-0"



ELEVATION OF GRADE SEPARATION

SCALE 1/8" = 1'-0"

CITY OF DETROIT

DEPARTMENT OF PUBLIC WORKS

OFFICE OF CITY ENGINEER

DIVISION OF GRADE SEPARATION AND BRIDGES

DESIGN FOR PROPOSED GRADE SEPARATION AT GRAND BLVD. EAST AND M. C. BELT LINE R.R.

GEORGE H. FENKELL, COMMISSIONER
CLARENCE W. HUBBELL, CITY ENGINEER
JOHN W. REID, ENG'R GRADE SEPARATION
HENRY E. RIGGS, CONSULTING ENGINEER

At the crossings of boulevards and main arteries of travel some additional expenditure over the standard type of construction is justified in order to secure the maximum of artistic effect, but the problem as a whole is one of elevating many miles of railroad and of building hundreds of bridges. It will cost many millions of dollars and should therefore be approached with perfect frankness; and, any unnecessary extravagance in expenditures avoided. Safety, cleanliness, noiselessness, permanence and sightliness are the things sought. These can be had with the type proposed.

VIII. The Opening, Closing and Changing of Streets.

In connection with the discussion of each of the three districts under consideration during 1917, the question of closing streets or changing streets has come up.

Whenever a railroad enters a large city, or builds a new terminal, railroad yard, station or other improvement, questions of change of existing public ways are almost sure to arise. The opening, closing, changing, widening, narrowing or changing the grade of the street or road may be essential to the carrying out of the plan, just as the new improvement is essential to the improvement of traffic facilities of the city. Every such case should be considered and decided upon its own individual merits, giving due weight to public, private and railroad interests which may be involved.

There are occasionally cases where in the elevation of tracks the closing or changing of streets may be economically wise.

In the Grand Trunk-Dequindre Street elevation we did not favor the closing of any streets now open between the Detroit River and Ferry Street because:

(a) These streets lead from the center of town to the easterly part of the city, and with but four or five exceptions practically all extended several miles, or led into streets which extended several miles east of the railroad.

(b) The population east of the railroad using these streets in going to and from the center of the city is now over a quarter of a million, and rapidly increasing.

(c) The streets are all very narrow.

While it is possible that some of these streets may never carry a large traffic, it is certain that when they are all improved by separation of grades they will carry a greatly increased traffic, and it would be difficult indeed to say that any one of these streets might be closed, except with the adoption, after careful study, of a comprehensive plan for opening and widening broad thoroughfares paralleling the main arteries of travel and of sufficient capacity to care for the traffic of a city growing so rapidly.

If the railroad paralleled the river at a distance of two or three blocks, the case would be vastly different and streets at double the interval would doubtless be ample.

It would appear that wise policy would dictate the following general program:

(a) Long through streets should all be maintained at full width.

(b) No closing of streets should be considered except in cases,

1. Of very short streets or of streets very near the river, where the traffic will always be limited.

2. To correct or eliminate a bad angle or approach near the subway.

(c) The opening of new streets, and the widening of existing streets should be considered as part of the grade separation project when traffic can thereby be so diverted and facilitated as to improve conditions in the grade separation district.

(d) In industrial districts cases may arise where the closing or changing of streets is of mutual benefit to industries, railroads and city.

As has already been pointed out, the streets of Detroit are too narrow, a condition that, in this age of motor vehicles, is fast becoming serious. The history of the past work in grade separation in other cities shows that more and wider streets are constantly demanded.

There is always grave danger that the closing of streets of any considerable length, now deemed unimportant, may be found to be a serious mistake in a few years as population and traffic increases.

There should, therefore, be a most thorough consideration of all proposals to close streets and none but the most convincing reasons should prevail.

We have recommended the closing of certain streets and opening of others in some districts, and direct particular attention to the subject, as we deem it of the utmost importance that all absolutely needed ways be kept open even if it involves greater expense of grade separation.

One fact which has been particularly impressed upon us in the preliminary investigations which we have made of the outlying districts is that the railroads are locating large

E. Washington Street, Indianapolis, Indiana.
Improper treatment of a main thoroughfare.

yards in areas where distances of several thousand feet occur between opened streets or roads. In many instances land has changed ownership, leaving the railroad right of way as the dividing line. Subsequent platting of these lands has been made with no reference to possible opening of streets across the railroad. Facilities which have proved ample in the past will be wholly inadequate in a few years. One or two such mammoth manufacturing plants as have been locating in Detroit in recent years locating in the vicinity, and the need for many and wider streets becomes urgent. We do not advocate a general opening of streets merely to anticipate and foreclose possible railroad use, but we do urge a careful

study of every mile of right of way within the city limits, the location of a sufficient number of streets connecting with main arteries of travel, and the taking of immediate steps to open them to ample width. Country roads sixty-six feet in width should be opened at least across the rights of way for the future avenues of eighty to one hundred feet.

We again feel urged to refer to the need of an adequate city plan of streets and roads, and call attention to the fact that the time to provide such a plan is before the grade separation contracts are made.

In the same connection we wish to sound a note of warning against the approval of plans for separation of grades on these outlying thoroughfares until full consideration of the future effect on the city is had. It may appear that a separation of grades on what is apparently a mere country road is highly desirable, especially when the crossing is near the throat of a yard, and the temptation to accept an offer of a railroad to do the work on a plan which introduces a cut of eight or ten feet, a couple of sharp angles or a couple of eighteen or twenty-foot driveways with thirteen feet or less of clearance, may be very strong. It is argued that the plan provided is more than ample for present needs, that the cost of a sixty or eighty-foot clear structure of fifteen-foot head room is prohibitive. The answer to this argument is that if the railroad proposes a large yard which contemplates the closing for all time of a mile or more of its line to crossing, it can well afford to provide very ample streets at each end and it must be compelled to make provision for future street railway lines and fully conserve all the rights of the public.

The conditions here discussed will be found on the Grand Trunk lines, Milwaukee Junction to the North and East city limits, the Detroit Terminal Line, the Michigan Central Bay City Division and, to a small extent on the Pere Marquette lines. We are not generalizing; the conditions and dangers referred to will be found on twelve or fifteen miles of line at least in the City of Detroit.

IX. Apportionment of Cost of the Improvement.

The agreements under which the Detroit work has been done have provided for the division of cost of the work between the railroad and city as follows:

The steam railroads have paid for the entire cost of the physical construction on the right of way and in the streets. The city has paid all property damages. The street railway has paid all the expense of the temporary work needed to maintain traffic and all of the new street railway track and overhead work.

Unfortunately there have been no full and adequate records of cost of past work in the city. The Division of Grade Separation was established as a separate division of the City Engineer's office in January, 1917. Prior to that date there has been no record of costs of grade separation work kept in the office of the City Engineer, and all the City of Detroit expenditures have been authorized by other departments. Each steam railroad has done its own work, kept its own costs in its own way. The street railway has done the same thing.

An effort has been made to determine the total charges to grade separation between 1900 and 1917. It is believed that these figures fail to disclose in full the costs of maintaining traffic.

The figures are as follows:

The City of Detroit, Property Damages	$ 850,000.00
Michigan Central Ry. Construction	2,863,993.00
New York Central Ry. (L. S. & M. S.) Construction	812,604.00
Grand Trunk Ry. Construction	1,359,197.00
Wabash Railway Construction	44,922.00
Detroit United Ry. Construction	93,000.00
Approximate Total Cost to date	$6,023,716.00

This does not include any of the work of constructing viaducts over the tracks of the Michigan Central or Grand Trunk Railways, no record of which is available.

It appears from the figures submitted that the cost of property damages is much greater when the streets are lowered eight to twelve or fourteen feet, as has been done in Detroit, than when the elevation of the railroad is greater and the change in the street is less.

It has been generally understood that the cost to the city has run from 20% to 25% of the total cost. It is very probable that with greater elevation of the railroad tracks the cost of property damages will reduce, and if the same arrangement is continued in effect, the city's proportion of the cost would be decreased.

An approximation of the amount of work that yet remains to be done is as follows:

Crossings now under contract	20
Crossings to be agreed upon	205
Total to separate	225

This does not take into account crossings of the various streets by new Pennsylvania lines yet to be built, nor does it consider streets crossed by industrial sidings, nor streets which should, and probably will, be opened in the immediate future.

If we assume that the cost of "Plan O" of the Grand Trunk line fairly represents the cost as of March, 1917, and it is assumed that costs will return to this figure after the war, we find that this estimate calls for $151,887 per street on which the grade is separated, or over $2,200,000 per mile of line. Applying these figures to the entire city on the basis of 220 crossings at $150,000 per street, a cost of $33,000,000 would result. On a basis of cost per mile of line the Grand Trunk figure would be greatly excessive, as the streets are very close together on this line. We may fairly assume that all parties at interest will be obliged to expend before the entire grade separation is an accomplished fact from $30,000,000 to $50,000,000. Closer estimates must follow much more complete surveys and studies than are now completed. This great undertaking must needs be spread over a period of 12 to 15 years after construction begins. It ought not to be allowed to drag at the present rate, which would require at least 50 years to carry out the entire separation of grades for crossings now in existence.

We may very properly discuss the methods which may be considered for a division of this cost. These methods may be stated as follows:

1. A division along definite payment for certain parts of the work by one party and certain other parts by the other party.

The present plan in Detroit clearly conforms to such a method.

2. A division by the payment of agreed percentages of the total cost by each party.

The present Michigan laws provide for the division of expense, in cases of grade separation, as follows:

Separation, how made.

Changes of grades.

Railroad Co. to build, etc., bridges, etc.

Street over Railroad.

Railroad over Street.

Act 268. Am 1909.

(396) §4255. Sec. 27. The separation of grades provides for either in the said agreement mentioned in section two or in the resolution, certificate or report attached to the petition provided for in section eleven as the case may be, shall be made and carried out in accordance with the plan, plat and profile, set forth in said agreement, resolution, certificate or report. All changes of grades in any railroad or railroads consequent on said separation of grades, shall be made and carried out by the railroad company or companies operating the same. When, according to said plan of separation of grades, the **street or highway will cross the railroad by an overhead bridge, the frame work of that part of said bridge within the side lines of the right-of-way and all abutments and supports sustaining that part of said bridge, shall be built, maintained and kept in repair by the railroad company,** or where such bridge crosses the right-of-way, of more than one railroad company, by said companies, where, according to said plan of separation of grades, the street or highway will pass under a railroad or railroads, **the railroad bridge, its abutments and the sustaining walls along the highway within the side lines of its own right-of-way** shall be built, **maintained** and kept in repair by each **railroad company. The surface and approaches of such bridge over which** the street or highway passes, and such public way under such railroad or railroads and the approaches thereto shall be constructed, **maintained and kept in repair by the township, county or city within which the same are situated,** or in the case of line crossings, by the joint action and under the joint supervision of the representative board or officer of the county or township and of the persons or bodies in whom by the charter of the city, the power to contract for and supervise the pavement of streets is vested, as the case may be. The expense of all work to be done by any railroad shall be paid by said railroad, or in case work is to be done by two or more railroads jointly the expense shall be shared equally among them. The expense of all work to be done by any city, county or township shall be paid by such city, county or township, or in case work is to be done by a city, and county or counties, township or townships jointly, the expense shall be shared equally among them. Such expense imposed on any city, county or township, shall be provided for by taxation in like manner as its other expenses are provided for.

In connection with the hearings of the Grand Trunk Railway plans, estimates were carefully made of the division of cost on the basis of a division under the law, the city paying all property damages.

This division resulted as follows:

	Plan O	City Plan
Street costs, City proportion	$ 632,759	$1,104,928
Property damages, City	700,000	900,000
	$1,332,759	$2,004,928
Street costs, Railway proportion	$2,223,516	$1,532,028
Right of way costs between streets	3,101,725	2,843,044
Additional property for Railroad	.....	400,000
Total Railroad proportion	$5,325,241	$4,775,072
Costs to Utility Companies in City	77,000	150,000
Percentage of total cost to City	20%	30%

It would appear from these figures that where the plan of the grade elimination district is such as to reduce the very excessive property damages that accompany the lowering of streets ten to sixteen feet, the division of costs, as indicated by the state law, places a very reasonable proportion on the city, when these costs are added to the lower damages.

That the city should pay at least from 20% to 25% of the costs of a permanent and well-designed improvement would seem to be reasonable, and the assumption of the entire maintenance of the streets by the city is eminently proper.

The new charter of Detroit appears to contemplate payment by the city only of property damages. Any change of plan which would place on the city a definite percentage of the cost would probably have to be passed upon by the courts. The general program here recommended would very greatly reduce, and in some cases eliminate, abuttal damages; hence the city's share of the cost. There is certainly equity in the claim that if the city receives a greater benefit from the improvement it ought not to be excused from paying at least as much as it would be compelled to pay for the less desirable plan.

The presence of the street railway in the street raises questions which may well be given careful consideration.

The Street Railway, if on private right of way, would be compelled to bear a very large proportion of the cost of separation of grades, much larger than the mere relaying of its tracks, and the reconstruction of its proportion of the paving. Whether the company should not bear such a proportion of the cost of the street portion of the work as its traffic bears to the entire traffic on the street, is a question that may well be considered. An investigation of the history of the D. U. R. grade separation on its entire system shows that costs have been as follows:

Fourteenth Avenue Subway	$14,255.81
Grand River and Warren Subway	31,851.04
Michigan Avenue Subway (2)	14,220.10
Woodward Avenue Subway	5,792.94
Beaubien Street Subway	26,678.08
Greenwood Avenue Subway	.....
Junction Avenue Subway*	.....
Trumbull Avenue Subway*	.....
	$92,797.97

*D. U. R. tracks built after or during construction of subway.

These figures do not include cost of operation of temporary tracks, but are complete as to actual cost of construction of temporary tracks and partially complete as to permanent tracks and payments to the railroads for a proportion of subway costs.

The solution of the street railway question is, of course, not a matter for consideration at this time, but the fact that the street railway should be made a party in all grade separation work where their tracks are involved is a thing that should be passed upon by the proper authority. It appears on analysis of the D. U. R. costs that of the above sums $21,845 was paid to the railroads to cover cost of excavating, changing sewers and water pipes, engin-

Grafton Street, Worcester, Mass.

Concrete Arch. Span 60 feet. Clearance 16 feet. Type not suitable for such a location.

eering and city inspection, the balance being the cost of laying and taking up the temporary tracks and building the permanent tracks. That the company should build its own tracks is very clear; that it should pay more than 2% to 3% of the cost of the actual separation would also seem to be clear.

The interurban lines of the D. U. R. have in almost every instance borne a large part of the cost of grade separation. Many interurbans have been compelled to bear the entire cost. Had the D. U. R. been made to pay in proportion to the interurbans, it would have borne over eight times its reported cost on work now completed.

Municipal utilities—gas—electric and other companies owning underground conduits may with propriety be required to care for the expense of making changes of their own properties to comply with the new street grades necessary to provide for the elimination of grade crossings.

The entire question of division of cost of such great improvements must be approached in a spirit of utmost fairness and with a realization of the fact that neither city nor railroad companies are responsible for the condition now existing, and that both will be the beneficiaries of the improvement.

In the cases of the Michigan Central and Grand Trunk, for example, both roads were built prior to 1840, when the population of the City of Detroit was less than 10,000.

The few streets which were open at the time had very limited traffic. The city has grown in population and area and new streets have been opened by the score, the traffic on the streets has doubled and quadrupled, the railroads likewise have grown, the number of tracks have multiplied and train movements have greatly increased, yet the whole development has been so gradual that neither city nor railroad has fully realized the magnitude of the problem that has been developing, each has aided the other, the railroad transportation facilities have made possible the great industrial growth, so that today neither party can with propriety claim that the other is wholly to blame for a condition that is now well nigh intolerable.

The problem today is to change that condition. The railroads cannot complain at being required to build the necessary railroad structure. The city cannot complain at being asked to bear the expense of changing street grades to make possible the improvement. It would seem that the state law was based on just this division, and that, assuming a reasonable elevation, it is perfectly fair. If the grades adopted are a compromise, to permit the railroads to avoid heavy elevation and to permit the industries to avoid change, then the city should not consent to pay more than property damages, as the streets are ruined for the benefit of others.

X. Effect of Grade Separation on Industries.

The elimination of grade crossings involves a radical change of conditions either as to a railroad level, which affects loading and unloading tracks and platforms, or as to street levels which affects the loading facilities for teams.

We cannot ignore the fact that other costs are involved than those of the railroad in changing its tracks and of the city in changing its streets.

Properties may be affected very differently, as shown by the following examples, all actual cases in the City of Detroit.

Example 1. Large Industry. Three or four large industries have acquired a tract of land of over 100 acres. The railroad runs along the east and north sides. There is a distance of over 4000 feet between streets, measured along the railroad. Long spur tracks reach all parts of the property. Conditions are such that with 15 feet elevation at one street and 10 feet at the other over 2000 feet of track may remain at its present level and none of the industrial sidings need be disturbed at all.

Example 2. Large Industry. The railroad runs for several blocks alongside an automobile factory. Street conditions require maximum elevation. None of the present sidings enter buildings. All incoming and outgoing freight is handled from platforms and

team tracks. The change of grade of the tracks involves elevation of platforms and yards and the building of approaches but in no wise affects any of the buildings.

Example 3. Large Industry. The buildings of this industry are located between two parallel streets on both sides of the railroad. The railroad frontage is less than 500 feet. Spur tracks lead off on both sides of the railroad and run between the buildings for a distance of several hundred feet. The present rate of curvature is over 30 degrees on these tracks. Owing to street railroad tracks and large shallow sewers the elevation must be at least 14 feet. To conform to new conditions the industry must elevate its spur tracks throughout their entire length and must rearrange all freight receiving and freight shipping facilities in its plant so as to receive and ship freight on the second floor.

Example 4. Large Industry. The plant occupies 100 or more acres of land. Railroad connections enter the property on each end crossing a street directly at the entrance and side tracks connect with these spurs so that a series of tracks are parallel with the street and are located adjacent to large buildings all of which have been erected to conform to the present track level. The elevation of tracks of fourteen feet at the street would involve elevating about ten miles of industrial tracks. This would necessitate costly changes in 30 or more large buildings none of which are readily adaptable to change.

Example 5. Small Industry. A warehouse is located directly on the tracks of the railroad. Its business is wholly inbound freight. While it is built to handle business from tracks on the present level, it can by installing elevators and readjusting its loading platforms, do business equally well if the tracks were 20 feet lower or 20 feet higher.

Example 6. Small Industry. The business has been carried on using tracks at the present level as there is no expensive plant involved. The elevation of the tracks will involve an expenditure which is not justified, either by the volume of business done or the area of land occupied.

These examples might be multiplied indefinitely. It is sufficient to say that each case offers its own problems. There are industries, large and small, which will not be seriously affected by track elevation. There are others which will be very hard hit by certain elevations. In general it is the small industry occupying one or two lots, with the small investment in plant that is most seriously affected by the cost of building the necessary track facilities on the new elevation. Undoubtedly there are some cases where removal to some other location will be the only solution.

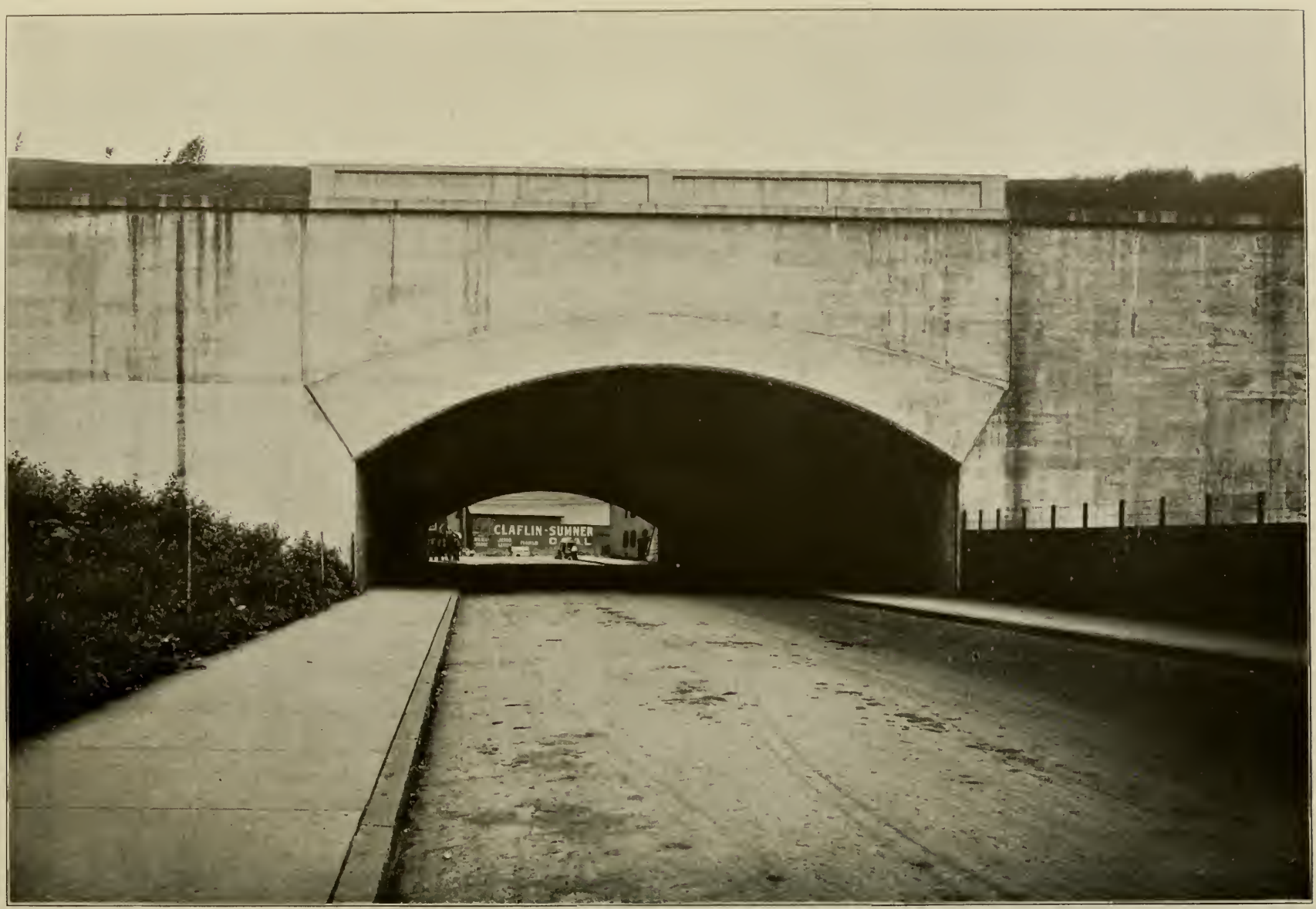
In developing the plans for track elevation we have given most careful consideration to all of these cases. We recognize the fact that the industrial life of Detroit is of most vital importance, and, only in cases where the general interests of the City in its streets is the greater interest have we recommended a grade line which might cause abandonment of site by an industry.

It has already been pointed out that track elevation to approximately full height is the cheapest solution in dollars and cents to the railroad. Such elevation comes most nearly to conforming to second story factory levels, and involves less readjustment, less reconstruction, and more favorable spur track grades, than an elevation of six or eight feet which was formerly sought as the best elevation for the industries.

All such industries as coal yards, material yards, warehouses, wholesale houses, are really better off with elevated tracks than with tracks on the lower levels, and when the plants are adjusted to the high level, they will be found to be capable of handling a greater volume of business than would be possible on the same area with tracks at the low level.

These conditions—and it must be frankly admitted that there are dozens of very perplexing cases—make all the more necessary prompt and united action between the City and the railroads in reaching an agreement on plans for future track elevation over the entire area of the City.

With Detroit's change, in fifteen years, from a residential city, ranking sixteenth in the value of her manufactured products, to fourth, and still moving upward, it is fair to assume that within the next 20 years, hundreds if not thousands of new industries, large and small, will be built along the lines of railroads within the City.



Hermon Street, Worcester, Mass.
Concrete Arch.
Span 50 feet. Clearance 16 feet.
Full elevation of the Railroad.

When track elevation is determined upon, and grades are fixed, it becomes possible for the owner to so build his plant that when the change is made, his buildings will conform to the established grade. It permits the railroad to provide for future elevation in the leases and side track contracts. It eliminates the element of property damages, as notice is served on all owners, of future changes in street grades in advance of his construction of buildings, and above all it obviates the necessity of adjustment and compromise of grades on parts of the railroad mileage not now filled with industrial plants.

We are firmly of the opinion that these plans should be pressed to completion at as early a date as possible, and that, as fast as new territory is added to the city, the elevation district should be extended.

XI. Program of Construction.

It has already been pointed out that the rate of progress possible under existing contracts is not satisfactory and that it is not keeping up with the rate of growth of the city.

It has also been indicated that the present problem involves at least 225 grade crossings which are now active sources of danger and delay to traffic.

A study of outlying districts in Detroit clearly indicates a considerable number of streets, not now open, which must be opened. Hence any program adopted for future construction must take into account:

(a) All the lines of railroad within the city limits;

(b) All existing crossings;

(c) All crossings which may not now be open which are necessary to furnish traffic outlets to the new sections of the city.

The present program, as in effect under existing contracts, provides for an expenditure of $200,000 per year on the part of the railroads. As already indicated, the plans when complete will cover work which will cost not less than $30,000,000 to $50,000,000. Accepting the higher figure as being a reasonable basis for preliminary discussion it appears that an average rate of considerably less than ten times the present is needed to complete this work within fifteen years, and when we takeinto account the uncertainty, due to the war, as to when this program could be started, we are fixing the time of completion at between 1935 and 1940 when Detroit will probably have a population of close to 1,500,000.

To carry out this program an amount should be fixed in the contracts, which, starting with a reasonable amount, should steadily increase each year, placing the heavier burden on the later years of the period.

The adoption of a complete plan for the entire city makes possible the separation of the heaviest traffic streets first, and for the carrying on of work in different parts of the city and on different properties, at the same time so that no undue burden shall fall on any one railroad in any one year.

A program of construction which commences with an appropriation of $2,000,000 the first year and increases regularly at a rate of approximately $200,000 per year, and reaches $4,000,000 per year in the eleventh or twelfth year would appear to be a more rational program than one which set aside a larger sum at the outset.

To commence with less than $2,000,000 per year would be out of the question. **The Grand Trunk Railway-Dequindre Street line is the worst menace in the City of Detroit.** It is located parallel with Woodward avenue and only a mile distant, in the very heart of the most congested section of the city. This must be provided for certainly in not to exceed a five or six year program. Its estimated cost is $6,735,000.

The Michigan Central's Belt Line parallels the Grand Trunk Railway approximately one mile further east from Woodward avenue. Every argument which applies to one line applies with nearly equal force to the other.

The line from Fort Street Union Station to Delray is in densely populated territory. The cost of grade separation in this district has not yet been estimated but it will probably equal or exceed that of the Dequindre Street line. The need for the work is immediate and urgent.

There yet remains a large amount to do under existing contracts, therefore it is clear that without going into new sections of the city at all there is an expenditure of many millions required on these projects, all of which are urgent, and all of which should be completed in five years if the whole work in the city is done in fifteen. It may therefore be wiser to adopt a larger annual appropriation for the first five years, decreasing as the more urgent work in the congested districts is completed.

In any event it must be evident that the best thought must be given to this subject and some plan developed which will secure action. The railroads probably will advance the argument that the amount of money involved is far beyond their ability to finance. It must be kept in mind that Chicago has already spent more than is needed in Detroit, for grade separation, that vast expenditures for terminals in large cities have been made without any pressure on the part of the communities.

Philadelphia has in part at least, put the credit of the city behind the railroads and developed a financial plan which has made more rapid construction possible. It may well be that the need of providing for a large and steady amount of construction work for a period of a few years after the close of the war will be such as to justify the city in taking a much larger part in the financing of this work than has been contemplated in the past.

XII. Railroad Operation.

The taking over of the railroads of the United States by the Federal Government raises some very interesting questions as to the future operation of these properties, especially locally.

During the winter of 1916-17 and for some years previous, there has been serious complaint that the railroad facilities of Detroit were not adequate, that more roads, more tracks, better facilities, were needed. During 1917-18 this complaint was very greatly reduced on account of the embargo agreement between the railroads. The various properties in Detroit worked together and operated their lines in complete harmony, as a result of which the congestion of yards and tracks in the city was very greatly reduced and a much larger volume of business handled. The City of Detroit may well give some consideration to the question of railway operation within her limits.

Is it more advantageous to the city to have seven or eight competing lines, each operating as a unit, each contending for business, each attempting to reach the more important industries, each doing its own switching, each duplicating tracks, facilities and services already owned or performed by other lines, in the various sections of the city, or would not the city be best served by the operation of all roads within the metropolitan district as one operating unit or division? It is an undoubted fact that there has been a great duplication of investment by the roads. One main line to an industrial district can, with the necessary tracks and yards, serve all of the industries in the district. The building of a second, third or fourth line adds nothing but competition. For example, The Toledo Division and Bay City Division of the Michigan Central Railroad form a direct straight line across the city from Southwest to Northeast. With the exception of a few hundred feet between West Detroit and Michigan avenue this line is operated by both freight and passenger trains. Between the west city limits and Milwaukee Junction this line has been paralleled by the Grand Trunk Railway and Wabash Railway with freight spurs while the New York Central old main line is now used for freight only from West Detroit. These parallel lines have already expended some two and a quarter million dollars for grade separation in addition to what the Michigan Central has spent and must spend as much more. One railroad would serve the industries as well as four.

Another example. The Michigan Central has paralleled the line of the Pere Marquette-Wabash with its "exposition spur" for a distance of two miles, reaching the same industries. To elevate this line will cost well over a million dollars.

While it is a fact that competitive conditions that have prevailed in the past have been such as to make this duplication of lines necessary if any railroad is to secure a share of the business from industries located on the lines of other roads, it is equally a fact that the city has gained nothing and the industry but little. If the government continues to operate the roads nothing is gained by the combined operation of some of the lines, and it would seem sound business that they be taken up rather than incur the expense of track elevation.

If the government can successfully operate all of the lines in Detroit as one unit, may we not raise the query why can the railroads not reach such an agreement as will obviate the paralleling of existing established lines, or better still, operate all lines in the city, under direct agreement, as one operation division?

A day spent in the yards of a large industry reached by the tracks of several railroads, will disclose the fact that the switching to and from industrial plants as ordinarily carried on results in a large amount of duplicated effort. Instances have been noted where yard engines of three or four roads have each spent from one to two hours and each engine has shifted every car in the plant. One switching crew in the time spent by it could have done the same work as done by all with one third the interference to operations in the industry.

This discussion is inserted here to direct attention to the facts,

(a) that the present system of operation is wasteful of investment and of work;

(b) that it greatly multiplies movements of trains over grade crossings adding largely to the danger of these crossings as a large proportion of accidents are caused by switching movements.

(c) That the city, as well as the railroads, is vitally concerned in the operations of the roads and that much of the cause for complaint can be traced back to failures of the roads to co-operate.

Whether new industrial lines paralleling old ones should be encouraged is a matter of policy to be decided by the city council. It would seem to be reasonable that all new lines should be required to establish grade separation at the outset. No new line should be allowed to cross streets at grade.

In the same connection attention is called to the desirability of carefully restricting the granting of industrial spurs from existing lines which cross streets at grade. It would appear that no such grant should be made that is not absolutely limited by strict regulations as to operation, and all such grants should be temporary, conditioned on full grade separation as soon as the connecting main track is elevated, and the elevation plans should be made and agreed to before the permission is granted.

XIII. History of Grade Separation in Detroit.

The earliest work done in the way of grade separation in the City of Detroit was in connection with the building by the railroads of the bridges over the Grand Trunk Railway and Michigan Central Railway many years ago. Of this work there is no record in the city files so far as we have yet found. In 1890-91 the construction of the Fort Street Union Depot led to the building of the viaduct and the West Jefferson street viaduct over the Michigan Central. At about the same time the building of East Grand Boulevard was accomplished and the viaduct over the Grand Trunk was completed as a part of that project. It thus appears that nearly all of the existing viaducts carrying the streets over the railroads were built prior to 1895 and were in no sense connected with any general plan for general grade separation. Both the Michigan Central and Grand Trunk, near the river, were in quite heavy excavation and the overhead viaduct was the obvious treatment for the local condition.

The general subject of separating street and railroad grades was a matter of recurring discussion and comment both in the Common Council and on the part of the city's executive department, in successive annual messages, for a number of years prior to 1900.

In that year the development of a large, rapidly growing residential section north of the Boulevard, easterly and westerly from Woodward avenue, brought about strong agitation which resulted in an agreement in August, 1900, for the separation of grades at Woodward avenue at the crossing of the Michigan Central, New York Central and Grand Trunk Railroads by partial elevation of the tracks of said companies and partial depression of the street. (See Journal of Common Council for 1900, pp. 649-52.) This work formed the basis of the agreement entered into July 3, 1903, providing for the construction of subways at all streets from Woodward Avenue to and including Michigan Avenue and also provided for the construction of a viaduct over said railroads at Junction Avenue. The required annual expenditure was not to exceed $200,000. All construction cost was borne by the railroads and the city paid such damages as were awarded to abutting property owners. (See Journal of Common Council for 1903, pages 610-617.)

Under this agreement 23 streets were completed at a cost to the railroads of $2,313,155.51. Grand Boulevard West was built entirely at the expense of the City of Detroit, by the Department of Parks and Boulevards. Seven streets have not yet been separated which are provided for in this agreement.

By an agreement dated May 15, 1906, the contract of 1903 was amended to provide for the construction of a subway in Junction Avenue instead of the viaduct agreed upon in the agreement of three years before. (See Journal of Common Council for 1906, pages 535-6-7.)

The Michigan Central's Detroit River Tunnel project and the consequent necessary rearrangement of this company's terminal facilities to meet the new conditions was probably the greatest influence in crystalizing the agitation, which had become quite acute, for grade separation by track elevation on all streets crossing the Michigan Central main line between 16th Street and Livernois Avenue, the then westerly limits of the city, resulting finally in an agreement between the Michigan Central Railroad and the City, dated October 17, 1906. (See Journal of Common Council, 1906, pages 1179-83.) The work under this contract has been fully executed at a cost to the railroad company of approximately $1,750,000.

In 1909 a further agreement was entered into providing for track elevation easterly from Woodward Avenue to and including Russell Street and East Grand Boulevard. This agreement simply extended the one of July 3, 1903, over the added area and spread the annual expenditure of $200,000 over the several streets to be affected by said agreement. (See Journal of Common Council, 1909, pages 1146-50.)

Seven streets have been completed under this agreement at a cost to the railroads of $653,313.37. Two streets remain to be separated. Brush Street was opened across the railroads as a part of the general improvement, the city paying to the railroads the sum of $12,000 for the opening.

The annexation to the city in 1906 of the Villages of Delray and Woodmere and a portion of Springwells, and the subsequent rapid settlement and development of this area, both as an industrial and residential section, crossed, as it is, in several places by main line tracks of railroads entering Detroit from the west, only added to the city's grade separation problem.

After considerable study and discussion covering one of the larger problems in this added territory, an agreement was consummated May 29, 1916, and amended September 26, 1917, covering the territory from the present grade at Junction Avenue southwesterly to the River Rouge on the lines of the Michigan Central—Toledo Division—the New York Central and Wabash Railroads and the Pere Marquette and Wabash main line tracks where the same cross Dearborn Avenue. (See Journal of Common Council 1916, pages 1462-66.)

Work was to have commenced in April, 1917, on Livernois, Dix and Waterman Avenues, but owing to war conditions the New York Central and Wabash Railroads appealed to the Common Council for permission to defer this work until conditions again became normal. (See Journal of Common Council 1917, pages 599-600.)

This contract provides for the opening of Green Avenue and Lafayette Avenue without expense to the City, and for the abandonment of Herkimer Avenue and the partial abandonment of Harbaugh Avenue.

There is also partial separation of grades on the Michigan Central main line at Central Avenue and Lonyo Road. The building of a hump yard in the year 1913 for the classification of freight made it necessary to elevate and relocate certain freight tracks. This work was covered by two separate agreements between the Railroad Company and the City of Detroit and the Township of Springwells, entered into in the year 1915. The through passenger and freight tracks still cross these thoroughfares at grade. We have no record of the cost, to the railroad, of this work which was done in connection with the building of a very large yard.

Since 1900, under these contracts 43 grade crossings have been eliminated and two others have been partially separated. Thirty-six streets included in the contracts have not yet been separated, including three which carry street railways. The actual work completed comprises roughly one-seventh of the total number of crossings in the city.

In January, 1917, on the appointment of Mr. C. W. Hubbell as City Engineer, the Division of Grade Separation was established. John W. Reid was appointed Engineer in charge and Professor Henry E. Riggs of the University of Michigan was retained as Consulting Engineer.

Work was commenced, and has been carried on continuously on a study of the entire problem of grade separation for the city.

The Grand Trunk Railway grade separation was the first specific problem to receive attention. This railroad, built prior to 1850, enters the city on Dequindre Street, one mile east of and parallel with Woodward Avenue the chief retail business street. It runs through a section of the city having a population of from 36,000 to 50,000 per square mile. The streets are narrow and close together. About one-third of the entire population reside east of this line. Belle Isle Park, the water works, many large industries and some of the finest residential districts lie east of the line, so that the total number of individual movements per day over the tracks runs into the millions. There are 44 streets involved between Detroit River and Ferry Avenue, many of which are heavy traffic streets, two of them, Jefferson Avenue and Gratiot Avenue, carry from 8,000 to 15,000 vehicles per day in addition to street cars, while there are street car movements of 1,280 and 2,800 per day respectively. Some of the worst crossing accidents in recent years have occurred on these streets, and from every point of view this grade elimination project is the most urgent in the city. This project has been under discussion for about fifteen years. The Common Council and the railway company had been unable to agree, therefore in 1914 the Council petitioned the Michigan Railroad Commission for an order compelling grade separation. Various plans had been made and modified, by both Railroad Company and City. In 1917, when the Division of Grade Separation assumed charge the plan before the Railroad Commission, known as "Grand Trunk Railroad, Plan N," provided for six to eight feet elevation of the railroad and eight to eighteen feet depression of the streets.

It was our opinion that this plan was wholly improper. New plans were immediately prepared which provided for depression of the Grand Trunk tracks over part of the district. The present railroad yard from the passenger and freight station is on a substantially level grade about 4 feet above high water. This grade carried under Jefferson Avenue, permits ample drainage. A rising grade of four-tenths of a foot per hundred feet to Macomb Street, and a grade of one foot per 100 to Alexandrine Avenue, provides perfect drainage, the same alignment as proposed by the railroad, the same maximum grade as the road now operates, and puts the tracks some 20 to 22 feet below the correct grades of all streets.

This plan was submitted to Council Feb. 28th, 1917, with a full report setting forth the comparison of this plan with Plan N. (See Common Council Proceedings, Feb. 28, 1917.) This plan was approved by the Council, and became known as the "City of Detroit Plan."

At a hearing before the Michigan Railroad Commission on March 9, 1917, the City Plan was offered as a substitute for Plan "N" and on the strength of the showing made the railroad

company withdrew "Plan N" and offered in its stead "Plan O," which provides for 3-foot elevation at Brush Street Station, a maximum elevation of 22 feet between Riopelle and Gratiot Streets and which comes to the city plan grades at Alexandrine Avenue and conforms with the city plan to Ferry Avenue.

Plan "O" eliminates nearly all of the objectionable features of Plan "N," but places the maximum grades in the railroad yards along the river front. The city therefore still contends for the adoption of the City Plan.

This matter was finally argued before the Michigan Railroad Commission in the spring of 1917, but to date the Commission has withheld its decision, presumably on account of the unsettled conditions due to the war and the government control of railroads.

It is to be hoped that this decision may be handed down shortly, even if the order as to time of commencement of work be deferred until the close of the war, as the question of the plan to be adopted is vital to any new industrial development in the territory, and the Commission's opinion as to proper division of costs of construction will have great value in connection with the making of future agreements with other railroads.

Incidental to the prosecution of the Dequindre Street (Grand Trunk) case, the New York Central (L. S. & M. S.) Railroad Company relinquished its perpetual rights over the Grand Trunk right-of-way and ceased operation of its trains into the Brush Street Terminal, and is now using the Michigan Central Station.

XIV. Review of the Work of the Division of Grade Separation.

Since its organization in January, 1917, the Division of Grade Separation has kept steadily at work, with a small force of men in the field part of the time and with one to two men in the office all of the time. The work done to date may be very briefly described under the following captions.

Grand Trunk Railway Project.

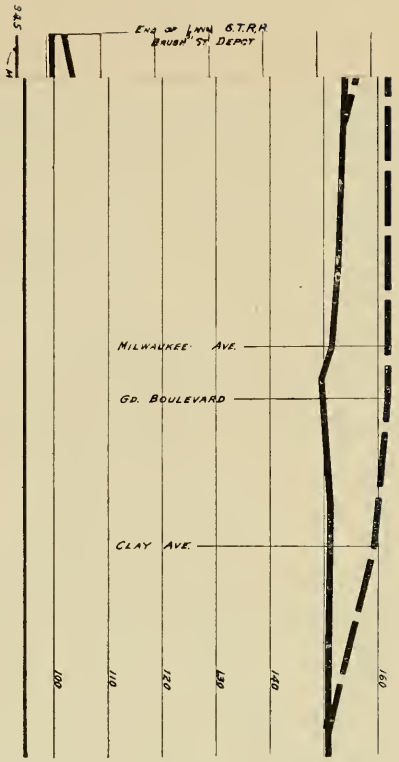
The first five months was almost wholly devoted to the study of the Grand Trunk Dequindre Street grade separation, the preparation of plans known as "The City Plan," to numerous conferences with Grand Trunk Railway engineers and preparation of estimates of cost which were agreed to by both parties, and to preparation for and attendance on hearings before the Michigan Railroad Commission.

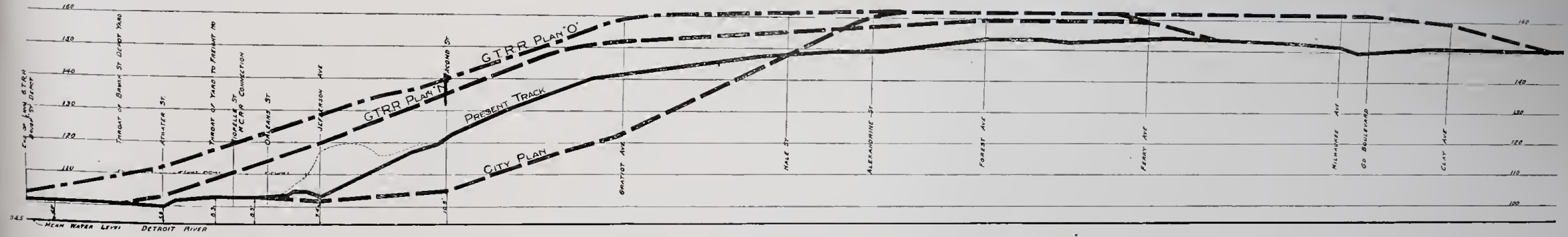
Pere Marquette-Wabash-Pennsylvania Project.

On February 13, 1917, the Common Council directed that investigations be made and plans prepared for the elimination of all grades on the main lines of the Wabash Railroad and Pere Marquette Railroad from Fifteenth Street to River Rouge. (See Journal of Common Council, 1917, page 167.)

Surveys were made, traffic counts on all of the streets taken and the work gotten well under way in the early months of 1917.

This project involves about four miles of main line now jointly used by the two railroads. The matter is involved by the fact that the Pennsylvania Detroit Railroad contemplates the use of these tracks and of the Fort Street Union Depot, and the contracts already made provide for extensive changes, including the building of additional main tracks making a four-track line. Still further complications are brought about by the existence of several long industrial spur tracks, leading off nearly at right angles, which cross several streets; by the connection with the main line and some of the spurs with the tracks of the Detroit, Toledo and Ironton Railroad and the Delray Connecting Railroad; by the paralleling of the main line for over a mile by the Michigan Central "Exposition Spur"; and by the character and extent of industries and of side tracks owned by the industries. Taken as a whole the problem resolved itself into the study of the entire district lying between Fort Street and the Detroit River extending from West Grand Boulevarrd to River Rouge. The entire district is


345
End of Lynn & B.T.R.R.
Beverly St. Depot
Milwaukee Ave.
Gd. Boulevard
Clay Ave.
100
110
120
130
140
150



PROFILE

SHOWING RELATION OF VARIOUS PROPOSED CHANGES OF GRADE TO THE EXISTING GRADE

DEQUINDRE STREET GRADE SEPARATION

DETROIT, MICHIGAN

FEBRUARY 28, 1917.

GEO H FENKELL, COMMISSIONER
CLARENCE W HUBBELL, CITY ENGINEER
JOHN W REID ENG'R GRADE SEPARATION
HENRY E RIGGS, CONSULTING ENGINEER

gridironed with railroads, not only the north and south streets but the east and west streets have numerous grade crossings and many serious questions were raised by industries.

After completion of surveys and maps, numerous conferences were held with the chief engineers of the railroads at interest and with the officials of industrial plants which were affected, and finally a system of grades established for the main lines which in the main met with the general approval of the railroad engineers, the engineer of the Wabash road being unable to agree due to the effect on the Wabash yard. The treatment of the various industrial and connecting lines was tentatively fixed, subject to adjustments on working out of full plans. These plans, together with a full report on the problems encountered, with recommendations, was reported to the Council Committee on July 15, 1918, and accepted and adopted by the Council on July 16. (See Journal of Common Council 1918, page 899.) This entire matter has been referred to the Grade Separation Committee, the Commissioner of Public Works, the City Engineer and the Corporation Counsel to negotiate an agreement.

The Michigan Central Belt Project.

The Michigan Central Belt Line extends east along the river from Orleans Street, where it connects with the Grand Trunk, to and across Mt. Elliott Avenue, thence leaves the river, crosses under Jefferson Avenue and runs parallel with Beaufait Avenue, about two miles east of Woodward Avenue, north to a connection with the Bay City Division in Hamtramck Village. The total length of this line is over five miles. Twenty-five streets in Detroit and one in Hamtramck are involved. From Jefferson Avenue northward the line parallels the Grand Trunk and the same objections to leaving it at grade apply, perhaps slightly less in degree at the present time.

While no resolution had been passed in 1917 by the Council, it was our opinion that this was among the most urgent of all projects in the city, and surveys were made. Several conferences have been held, with the Chief Engineer and Grade Separation Engineer of the Michigan Central, maps and profiles have been prepared, and good progress made toward reaching an agreement as to the final elevation to be adopted. Plans for this project, together with discussion of local difficulties to be overcome will be ready for submission to Council within a few weeks.

Other Grade Separation Projects.

Preliminary inspection has been made of nearly all other lines in the city. Some surveys have been commenced and, if a sufficient force of men can be secured will be done this year for the Pere Marquette lines in the western part of the city, the Detroit Terminal Railway, and the Michigan Central and Grand Trunk lines northeast of Milwaukee Junction.

General Studies. Grade Separation in Other States and Cities.

In January, 1917, it was found that the city files contained little or no information as to laws of other states bearing on grade separation, and that only one or two reports on such work were available. The task of assembling, in convenient form for ready reference, all information bearing on the subject was at once undertaken, with the result that the Division of Grade Separation now has accumulated a mass of information in the form of laws, plans of work, reports on grade separation in various cities, photographs and books, and has quite a complete bibliography of the subject. An abstract has been made of this data showing for each state a reference to the laws governing grade separation, the manner of division of cost of the work, the percentage of cost borne by the cities, and the cities which have done work of grade elimination. This abstract appears as Appendix A to this report.

Traffic Studies.

We were greatly handicapped at the very outset of our work by lack of accurate data as to the use of the streets by street cars, vehicles and pedestrians. No traffic counts had been made by the city in connection with previous grade separation work, consequently we had no basis for stating increase of traffic on any of the streets of Detroit. Quite extended studies have been started with a view of securing accurate data as to:

(a) The actual extent of use of the various streets on each project. This is essential particularly to meet the requests of the railroads for closing of streets.

(b) The growth of traffic on improved streets under fairly normal conditions. The increase in population and manufacturing means a greatly increased use of the streets each year and it is essential that this rate of increase on fully built and well established streets be determined.

(c) The growth of traffic on streets due to the improvement of the street. It is invariably the case that vehicular traffic tends to use the better paved thoroughfares and in many instances wrong conclusions as to the importance of an unimproved street may be reached.

(d) The growth of traffic in outlying districts due to the establishment of new industries. There is a marked tendency to underestimate the importance of main thoroughfares in newly added sections of the city. This tendency may be overcome by the possession of definite records extending over a period of four or five years in the case of such roads as Dix Avenue, Ferndale Avenue, Mt. Elliott Avenue, and other streets which have become main streets of newly built districts.

These records have not been accumulated for a sufficiently long period to permit us to draw any conclusions as yet on many of the points involved. By continuing our own records, and availing ourselves of those of the County Road Commission, State Highway Commission and D. U. R. we hope at a later date to submit further information of real value.

A summary of average daily counts made on 147 grade crossing shows over 1000 vehicle and street car movements per day per crossing, as against a railroad movement of 41 trains per crossing. See Table X.

TABLE X.

Average Daily Traffic across 147 Railroad Grade Crossings in Detroit, 1917, Based on Counts made under direction of Division of Grade Separation.

Railroads	No. Cros'gs	Train Movem'ts	Street Vehicle Movem'ts	Time Lost No. Crossings	Hrs.	Min.	Tresp's'rs on R. of W.
G. T. R. R. (D. & M. R. R.)	50	1755	50,854	36	29	51	14,857
Wabash, P. M. R. R's	34	2141	18.919	13	20	50	4,337
M. C., N. Y. C., Wabash	7	679	10,132	7	15	02	1,364
P. M. (old line)	6	102	8,714	4	2	18	515
M. C. (Bay City), G. T. R. R.	4	66	853	4	1	30	44
D. T. & I. R. R.	4	71	5,691	1	1	02	849
M. C. Belt Line	18	748	36,168	15	14	23	2,226
Detroit Terminal R. R.	24	456	17.251	9	3	24	849
Totals	147	6018	148,582	89	88	20	25,002
Average per crossing per day	..	41	1,011				

Accidents, Trespassers.

Considerable study has been made of all available statistical data as to crossing accidents and accidents to trespassers. This subject was discussed somewhat in our report of July 15, 1918. (See Journal of Common Council 1918, page 901.) No additional information has been gathered, hence no figures need be given in this report. Attention is called to the fact however that crossing accidents constitute a tremendously large percentage of all railroad accidents, while accidents to trespassers mount into the thousands each year in the United States. Table X shows that **25,000 trespassers per day** were counted at 147 grade crossing in Detroit. We have as yet been unable to secure full data from the railroads as to classified accidents in Detroit, but from such data as we have it is very clear that by the complete elimination of railroad grade crossings in Detroit the number of accidents will be very largely reduced.

Maps and Records.

The preparation of a large and accurate map of the City of Detroit, showing all railroad lines, location of all industries, location of all open and platted streets has been substantially completed. Project maps and profiles showing the correct location of all side tracks and yards have been prepared for all of those projects for which plans have been submitted, and will be made for all districts in the city. Study has been given to the subject of standard types of construction, and plans prepared as a basis for all estimating, and, with possible modification to meet railroad special requirements, or artistic needs of special cases, to be used as a basis for construction. Studies have been made of various plans for streets and driveways at complex crossings. Complete street plans and profiles, to comply with the provisions of the state law, have been made for all streets crossed by the railroad lines. It is hoped that within another year, certainly by the end of 1919, the record may be so full and complete for every crossing in the City of Detroit as to obviate the piecemeal field work that has been necessary in order to supply information to the Council.

The Establishment of Grade Separation Districts.

We have found the necessity of establishing some well defined districts, so designated that ready reference may be had to maps, plans and the mass of data that is accumulating. Reference to this work by the date of the contract with the railroads, as has been done in the past, or by projects, as outlined in the plans made under various Council orders, as was first adopted by us in 1917, will be found to be unsatisfactory as the work progresses. After consideration of several plans we have fixed on a plan for nomenclature of districts and subdistricts as set forth in Appendix B, and recommend its adoption. Every mile of line within the City is included in one of these districts. Single lines of railroad, or three or four parallel and adjoining lines are treated as line. The number of streets given in each subdistrict are streets crossed by the main line of road, not those crossed by industrial spurs.

Information Regarding Industries.

It has been the policy of the Division of Grade Separation to establish so far as possible the most frank and cordial relations with owners of industries, large and small, along the lines of railroad in the city. We have in general, met with a most hearty response, and have received many maps and layout plans, and in some cases have conferred with architects or engineers selected by owners. We have had many conferences with officials, have received a great mass of valuable information as to shipments in and out by rail and as to the local teaming at the various properties, all of which has enabled us to work with a much more intelligent knowledge of the requirements of each plant.

We trust that we may, in the future have the fullest co-operation with the owners of property, direct, rather than through attorneys representing groups of industries. It can only be through complete understanding of all points of view that the best interests of all parties can be conserved.

Acknowledgement.

We acknowledge the hearty co-operation of the officials of the railroad, in the furnishing of maps, track plans, profiles, plans of structures and in placing at our disposal records of cost. The officers of the Detroit United Railway, the Detroit Edison Company, Detroit Gas Company and the Telegraph and Telephone Companies have also responded to every request. This spirit of confidence and co-operation has made it possible to place the city in possession of information absolutely essential to the full execution of the work. Acknowledgment is also made of the generous co-operation and assistance of the Detroit Bureau of Governmental Research in the Grand Trunk-Dequindre Street case.

Very respectfully submitted,

JOHN W. REID.
H. E. RIGGS.

Appendices.

APPENDIX A. ABSTRACT OF LAWS GOVERNING GRADE SEPARATION IN VARIOUS STATES—DIVISION OF COST.

APPENDIX B. DESCRIPTIONS OF GRADE SEPARATION DISTRICTS, WITH LISTS OF STREETS NOW OPEN.

APPENDIX C. STREETS IN DETROIT HAVING GRADES OF MORE THAN 2.50% EXCLUSIVE OF GRADES IN SUBWAYS AND ON BRIDGE APPROACHES.

APPENDIX D. SUMMARY OF RAILROAD FACILITIES OF INDUSTRIES COMPILED FROM DATA PUBLISHED BY DETROIT BOARD OF COMMERCE TRANSPORTATION COMMITTEE.

APPENDIX E. MAP AND PROFILE OF DISTRICT 1-A.

APPENDIX F. MAP AND PROFILE OF DISTRICT 1-B.

APPENDIX G. MAP AND PROFILE OF DISTRICT 1-C.

APPENDIX H. MAP AND PROFILE OF DISTRICT 2.

APPENDIX J. MAP AND PROFILE OF DISTRICT 3-A.

APPENDIX K. MAP AND PROFILE OF DISTRICT 4-A-C-D.

APPENDIX "A."

Abstract of Laws Governing Grade Separation in Various States—Division of Cost.

State.	Laws Regulating Work.	Division of Cost Controlled by State Law.	Partial List of Cities Which Have Undertaken Work.	Division of Cost Controlled by Local Ordinance or Agreement.
Alabama	No grade crossing law		*Birmingham—1 viaduct built—1 viaduct to be built	City 30% R. R. 70% cost City 20% incl. damages R. R. 80%
Arizona	No grade crossing law			
Arkansas	No grade crossing law			
California	State law		San Jose: (damages to R. R. property borne by R. R. Co. St. Ry. paid track exp.) Except also R. R. track work	Railroad 50% City 35% County 15%
Colorado	State law	Discretionary with the Commission	Colorado Springs	City 25% R. R. 75%
Connecticut	State law	Petition by City Senior Highway R. R. 75%, City 25% Petition by City Junior R. R. 50%, City 50% Absence of application—State 25%, R. R. 75%	New Haven—A great amount of work done but no reports available	
Delaware	"Special Comm. determines and apportions cost"		Wilmington—Work mostly done years ago—no reports	
Dist. of Columbia			Washington—All grade crossings abolished—R. R. paid cost of all work within R. of W.	U. S. 50% D. C. 50%
Georgia	No grade crossing law	Not fixed	Atlanta—Several bridges and viaducts 10 crossings—city paid 38.85%	By agreement
Idaho	No grade crossing law "Jurisdiction limited to safety thereof"			
Illinois	State law	Not fixed—Each case handled on its own merits	Chicago—Authorized by City ordinance—passed under police power of charter Vast amount	By agreement R. R. construction City damages
Indiana	State law	R. R. 75% St. Ry. 5% City 14% or 17% County 6% or 8%	Indianapolis	R. R. entire cost

*General Plan

APPENDIX "A."

Abstract of Laws Governing Grade Separation in Various States—Division of Cost.

State.	Laws Regulating Work.	Division of Cost Controlled by State Law.	Partial List of Cities Which Have Undertaken Work.	Division of Cost Controlled by Local Ordinance or Agreement.
Iowa	State law	Not fixed		
Kansas	State law	Fair and equitable Land required R. R. pay 50% to 75%—this relocating highway		
Kentucky	No law Law fixes clearance 22' Except in cities having power under charter to regulate		Cities have power under their charters to regulate clearance for bridges over railroads	
Louisiana	No law			
Maine	State law	State 25% City 10% Railroads 65%		
Maryland	No State law		Baltimore—By City ordinance accepted by the railroads	Railroads have borne major portion of cost
Massachusetts	State law	City 10% State 25% Railroad 65%	Boston Springfield—No attempt to design artistic structures Lawrence—All but one or two crossings eliminated Lowell—No reports	City's share varied 13½%-15%-30%-34%
Michigan	State law	Not fixed	Detroit—43 crossings eliminated, 20 crossings covered by agreements. Case pending before State Comm. involving 44 crossings Grand Rapids—No information available	Agreement—R. R. pay construction costs City—Damages to property abutting the street
Minnesota	No law		Minneapolis—Work done under auth. of police power City Charter. H. & D. depression—38 streets latest St. Paul—Accomplished by City ordinance under police power of charter	R. R. pay all cost
Mississippi	No reply			

APPENDIX "A."

Abstract of Laws Governing Grade Separation in Various States—Division of Cost.

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Missouri	State law	Not fixed	Kansas City—Adopt ordinance for each particular case St. Louis—By ordinance under general welfare clause of charter	 R. R. pay construction cost City pays damages
Montana	No State law			
New York	State law	City 25% State 25% R. R. 50%	Rochester—1881 agreement Buffalo (Special law)	R. R. entire cost Agreement— R. R. 65% City 35% In R. of W. 100% Damage R. R. 55%, City 45%
Nebraska	No State law		Charter of various cities give authority to require elev. by means of viaducts Omaha—Track elevation	 R. R. entire expense
Nevada	No law directly covering elimination of grade crossings—but general provisions of R. R. Comm. law give authorty over such matters			
New Hampshire	State law	R. R. at least 50% and such per cent of balance as Comm. may award		
New Jersey	State law	R. R. entire cost, except changes in pipes, etc., and paving— Street Ry. 10%	Camden—Some work No artistic bridges	
New Mexico	No law			
North Carolina	No reply			
North Dakota	No law			
Ohio	State law	R. R. not less than 65%. City not more than 35%	Toledo—Lake Shore recently completed—elimination 7 crossings Cincinnati—R. R. 65%, City 35% If Street Ry.—50% of city's portion Dayton—No information furnished Columbus Cleveland	R. R. assumed entire cost

APPENDIX "A."

Abstract of Laws Governing Grade Separation in Various States—Division of Cost.

State.	Laws Regulating Work.	Division of Cost Controlled by State Law.	Partial List of Cities Which Have Undertaken Work.	Division of Cost Controlled by Local Ordinance or Agreement.
Oklahoma				
Oregon	State law	Not fixed Discretionary with the Commission	Portland—Problem receiving very serious consideration in 1914. See complete plans and bids 1916	
Pennsylvania	State law	Not fixed Determined by Commission	Cities—Auth. to enter into contract with R. R. companies Philadelphia—By agreement. Must be O. K.'d by Comm. Pittsburg Scranton	R. R. City 1892, 33 1-3% 66 2-3% 1897, 62 1-2% 37 1-2% 1900, 68% 32% 1906, 50% 50% Varied 25% to 50% to City City 60%
Rhode Island	State law	Not fixed Usually by agreement Cities pay ¼ to 13%	Providence—Only case in recent years covered two streets at Olneyville	R. R. 75%, City 25%
South Carolina	No reply			
South Dakota	No law			
Tennessee	No State law		Memphis—Ordinance Subway about to be constructed under special Act—R. R. pay entire cost, incl. damages Nashville—Never taken up the problem.	R. R. all physical construction St. Ry. pay cost of adequate clearances Property damage 50-50 up to $500,000 City pays all over $500,000
Texas	No statutes		Dallas—Mr. John F. Wallace prepared elaborate report for situation here Houston—Nothing done except re-routing over the roads and moving tracks	
Utah	State law (new)	Discretionary with Commission	Salt Lake City—Two viaducts over Denver & Rio Grande	R. R. entire cost
Virginia	State law (apply outside of cities)	R. R. 50% County 50%	Richmond—No grade separations. Several viaducts over natural cuts—Toll bridges	Owned by R. R. companies
Vermont	State law	Annual ex. based on miles of track		

APPENDIX "A."

Abstract of Laws Governing Grade Separation in Various States—Division of Cost.

State.	Laws Regulating Work.	Division of Cost Controlled by State Law.	Partial List of Cities Which Have Undertaken Work.	Division of Cost Controlled by Local Ordinance or Agreement.
Washington	State law	New R. R. cross. exist. highway entire cost. State not to exceed 10%. Otherwise Comm. may apportion	Spokane—Considerable work done	R. R. paid entire cost
			Seattle	R. R. franchise require payments of entire cost by company
West Virginia	State law (new)	Comm. apportions cost		
Wisconsin	State law	Comm. apportions cities' cost		R. R. all cost within R. of W. St. Ry. within own tracks. City balance and d nages.
Wyoming	No State law			

APPENDIX "B."

Grade Separation Districts—City of Detroit.

District 1.—River Rouge to Seven-Mile Road.

(a) M. C. R. R., Bay City Division..Woodward to Michigan.
Grand Trunk R. R.....Woodward to Junction.
New York Central R. R.....Woodward to Junction.

Woodward	Wabash	Twenty-fourth
Cass	Kirby	Twenty-fifth
Second	Fourteenth	Roosevelt
Third	Fifteenth	McKinley
Greenwood	Sixteenth	Vinewood
Holden	Grand River	Grand Boulevard W.
Lincoln	Warren	Scotten
Trumbull	Maybury Grand	Michigan
Commonwealth	Buchanan	Michigan
Twelfth	Twenty-third	Junction

(b) M. C. R. R., Bay City Div.....Woodward to Russell.
G. T. R. R.....Woodward to Russell.
N. Y. Central R. R.....Woodward to D. G. H. & M.
Wabash R. R.....Woodward to D. G. H. & M.

John R.	Hastings	Grand Boulevard E.
Brush	Milwaukee	Russell
Beaubien	Hastings	Russell

(c) M. C. R. R., Toledo Division...Junction to River Rouge.
N. Y. Central R. R.....Junction to River Rouge.
Wabash R. R. (Freight only)..Junction to Dearborn.

Livernois	Springwells	Carbon
Dix	Lafayette	Dearborn
Waterman	Lawndale	Herkimer
Green	Fort	
Central	Harbaugh	

(d) M. C. R. R., Bay City Division..Russell to Seven-Mile Road.
G. T. R. R.....Russell to Seven-Mile Road.

Clay	Conant	Davison (?)
St. Aubin	Mt. Elliott	Lansing
Jos. Campau	Six-Mile Road (?)	Seven-Mile Road (?)
Leuschner	Church	Van Dyke

District 2.—Third Street to Westerly City Limits, Western Avenue.

(a) Michigan Central R. R. (main line.....Third to Livernois.

W. Jefferson	Baker	Twenty-fourth
Fort	Fifteenth	Grand Boulevard W.
Lafayette	Sixteenth	Vinewood
Twelfth	Seventeenth	Scotten
Howard	Eighteenth	Clark
Vermont	Twentieth	Junction
Porter	Beecher	Military
Fourteenth	Twenty-third	Livernois

(b) Michigan Central R. R. (main line).....Livernois to City Limits.

Central		Lonyo

APPENDIX "B."

Grade Separation Districts—City of Detroit.

District 3.—Atwater Street to Eight-Mile Road.

(a) Grand Trunk (D. G. H. & M.) R. R.....Atwater to Ferry.

Atwater	Sherman	St. Joseph
Riopelle	Maple	Illinois
Orleans	Chestnut	Leland
Franklin	Antietam	Alexandrine
Woodbridge	Jay	Superior
Jefferson	Gratiot	Willis
Larned	Adelaide	Canfield
Congress	Division	Garfield
Fort	Alfred	Forest
Lafayette E.	Brewster	Hancock
Monroe	Wilkins	Warren
Macomb	Erskine	Theodore
Clinton	Scott	Farnsworth
Mullett	Hale	Frederick
Catherine	Mack	Ferry

(b) Grand Trunk (D. G. H. & M.) R. R.....Ferry to Eight-Mile Road.

Harper	Holbrook	Log Cabin
Trombley	Westminster	Seven-Mile Road
Milwaukee	Caniff	State Fair Road
Grand Boulevard E.	Davison	Eight-Mile Road
Clay	Jerome (6-Mile Rd.)	

District 4.—Third Avenue to River Rouge.

(a) Wabash R. R.....Third Avenue to River Rouge.
Pere Marquette R. R..... Third Ave. to Fort Street.
Penn.-Detroit R. R.....Third Avenue to River Rouge.

Sixth	Clark	Waterman
Brooklyn	McKinstry	Post
Eighth	Summit	Green
W. Jefferson	Ferdinand	Solvay
Twelfth	Morrell	West End
Nineteenth	Junction	Harbaugh
Twenty-fourth	Campbell	Dearborn
Grand Boulevard W.	Cavalry	Carbon
W. Jefferson	Military	Dey
Minnie	Dragoon	Gates
Swain	Artillery	Forman
Pleasant	Crawford	Barron
Campau	Rademacher	Fort

(b) Pere Marquette R. R.....Fort Street to City Limits.

Dearborn

(c) M. C. R. R., Exposition Spur...W. Jefferson to Westerly City Limits.

W. Jefferson	Artillery	Mackie
Reeder	Crawford	West End
Harvey	Rademacher	Cary

APPENDIX "B."

Grade Separation Districts—City of Detroit.

District 4—Continued.

Driggs	Waterman	Ford
Cavalry	Post	Dearborn
Military	Green	Harbaugh
Dragoon	Solvay	Leigh

(d) D. T. & I. R. R.....West End Avenue to D. C. R. R.

West End	Vanderbilt	Dearborn
Mackie	Thaddeus	W. Jefferson

District 5.—Dequindre Street to Joseph Campau Avenue.

(a) Michigan Central Belt Line....Dequindre to Joseph Campau.

St. Aubin	Kercheval	Warren E.
Dubois	Waterloo	Theodore
Chene	Charlevoix	Palmer E.
Jos. Campau	Berlin	Grand Boulevard E.
McDougall	Mack	Harper
Mt. Elliott	Pulford	Mt. Elliott
Jefferson	Sylvester	Dunn
Lafayette E.	Gratiot	Jos. Campau
St. Paul	Forest E.	

(b) Michigan Central Belt Line....Harper to D. T. R. R.

Strong	Wagner
Miller	Huber

District 6.—M. C. R. R. (main line) to Westerly City Limits.

Pere Marquette (old line).....Michigan Avenue to City Limits.

Michigan	Tireman	Wyoming
Buchanan	Livernois	Afton
McGraw	Plymouth	
Warren	Coon	

District 7.—Jefferson Avenue to P. M. (main line).

(a) Detroit Terminal R. R.....Jefferson to Woodward.

Jefferson	Gratiot	Ryan Road
Kercheval	French Road	Conant
Waterloo	Van Dyke	Jos. Campau
Charlevoix	Lynch Road	Dequindre
Mack	Mt. Elliott	Oakland
Shoemaker	Six-Mile Road	Woodward
Harper	Davison	

(b) Detroit Terminal R. R.....Woodward to Westerly City Limits.

Hamilton	Livernois	Tireman
Oakman	Glendale	Warren W.
Twelfth	Grand River	Lonyo
Linwood	Plymouth	

APPENDIX "C."

Streets in Detroit Having Grades of More Than 2.50%, Exclusive of Grades in Subways and on Bridge Approaches.

Street	Limits	Length in Feet	Per Cent of Grade
Bates	Jefferson to Woodbridge	200	4.50
Bates	Woodbridge to Atwater	200	4.13
Beaubien	Jefferson to Woodbridge	200	4.30
Beaubien	Woodbridge to Franklin	200.47	5.27
Brush	Jefferson to Woodbridge	200	4.10
Cass	Congress to Alley north	138	4.89
Dubois	Macomb to Alley north	95	6.10
Dubois	Clinton to Alley south	115.49	4.28
Fifth	Fort to	246.56	4.53
First	Fort to Congress	296	4.00
Griswold	Jefferson to Woodbridge	200	6.32
Griswold	Jefferson to Larned	200	3.03
Griswold	Congress to Fort	296	3.06
Hastings	Woodbridge to Franklin	200	6.50
Hibbard	Jefferson to 109′ north	109	4.58
Holcomb	Jefferson to 250′ north	250	4.00
Jefferson	Wayne to Cass	212	2.68
Jos. Campau	Jefferson to Woodbridge	200	2.70
Jos. Campau	Woodbridge to Franklin	200	2.50
Randolph	Jefferson to Woodbridge	200	4.42
Riopelle	Jefferson to Woodbridge	200	4.50
Riopelle	Jefferson to Woodbridge	200	4.50
Riopelle	Woodbridge to Franklin	200	3.00
Rivard	Jefferson to Woodbridge	200	3.27
Rivard	Woodbridge to Franklin	200	6.63
Second	Fort to Congress	296	3.91
Shelby	Jefferson to Woodbridge	200	9.44
Shelby	Jefferson to Larned	200	3.46
Shelby	Congress to Fort	296	3.20
Sixth	Congress to West Jefferson	155	4.00 4.74
St. Antoine	Jefferson to Woodbridge	200	3.40
St. Antoine	Woodbridge to Franklin	200	6.00
Wayne	Jefferson to Alley south	80	9.30
Wayne	Jefferson to Larned	200	3.00
Wayne	Congress to Fort	296	4.00

There is a total of approximately 1,340 miles of streets in the City of Detroit, 688 miles of which are paved. When fully developed the, at present, unplatted areas will add approximately 350 miles to this total, making nearly 1,700 miles of streets.

The 1.34 miles of streets having grades of more than 2.50% is less than one-tenth of one per cent of this total.

APPENDIX "D."

Summary of Railroad Facilities of Industries.

Railroad	Freight House	Industries	No. Sidings	Industries using team tr'ks	No. team tr'ks	Total cars capacity sidings	Total cars capacity team tracks
Delray Connecting R. R.	..	6	..	..	..	1,064	..
Delray Terminal R. R.	..	..	..	..	..	..	..
Detroit Terminal R. R.	2	110	211	7	7	2,367	280
Detroit, Toledo & Ironton	1	9	22	..	3	273	49
Detroit & Toledo Shore Line	..	4	15	..	..	210	..
Grand Trunk	5	228	426	31	7	2,560	651
Michigan Central	10	547	665	115	21	6,462	1,125
New York Central	3	12	22	..	2	859	124
Pennsylvania	..	113	153	..	..	1,716	..
Pere Marquette	..	43	54	..	12	705	311
*Pere Marq.-Wabash (joint)	..	57	77	4	7	675	253
Wabash Railroad	4	23	39	..	5	460	156

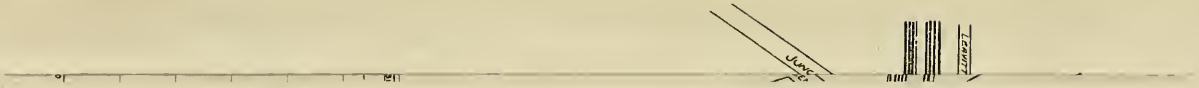
*Third Street Union Depot Lines.

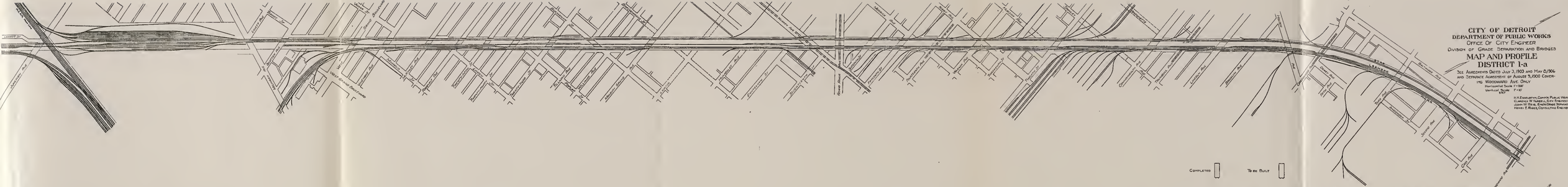
Detroit has 880 industries large enough to require private sidings.

Detroit has 159 industries located on railroads but using team tracks.

Detroit has 1600 sidings with a capacity of 15,635 cars serving these 880 industries.

The above information is from Industrial and Transportation Terminal map of Greater Detroit, compiled and published under the direction of the Detroit Board of Commerce.


JUNE
LEMMT



CITY OF DETROIT
DEPARTMENT OF PUBLIC WORKS
OFFICE OF CITY ENGINEER
DIVISION OF GRADE SEPARATION AND BRIDGES

MAP AND PROFILE
DISTRICT 1-a

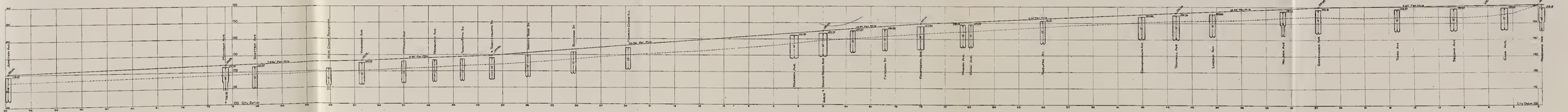
SEE AGREEMENTS DATED JULY 3, 1903 AND MAY 6, 1904 AND SEPARATE AGREEMENT OF AUGUST 5, 1900 COVERING WOODWARD AVE. ONLY

Horizontal Scale 1"=100'
Vertical Scale 1"=10'

H.H. EWALD, CITY ENGINEER
CLARENCE W. RUSSELL, CITY ENGINEER
JOHN W. REID, ENGR. GRADE SEPARATION
HENRY E. RILEY, CONSULTING ENGINEER

COMPLETED

TO BE BUILT



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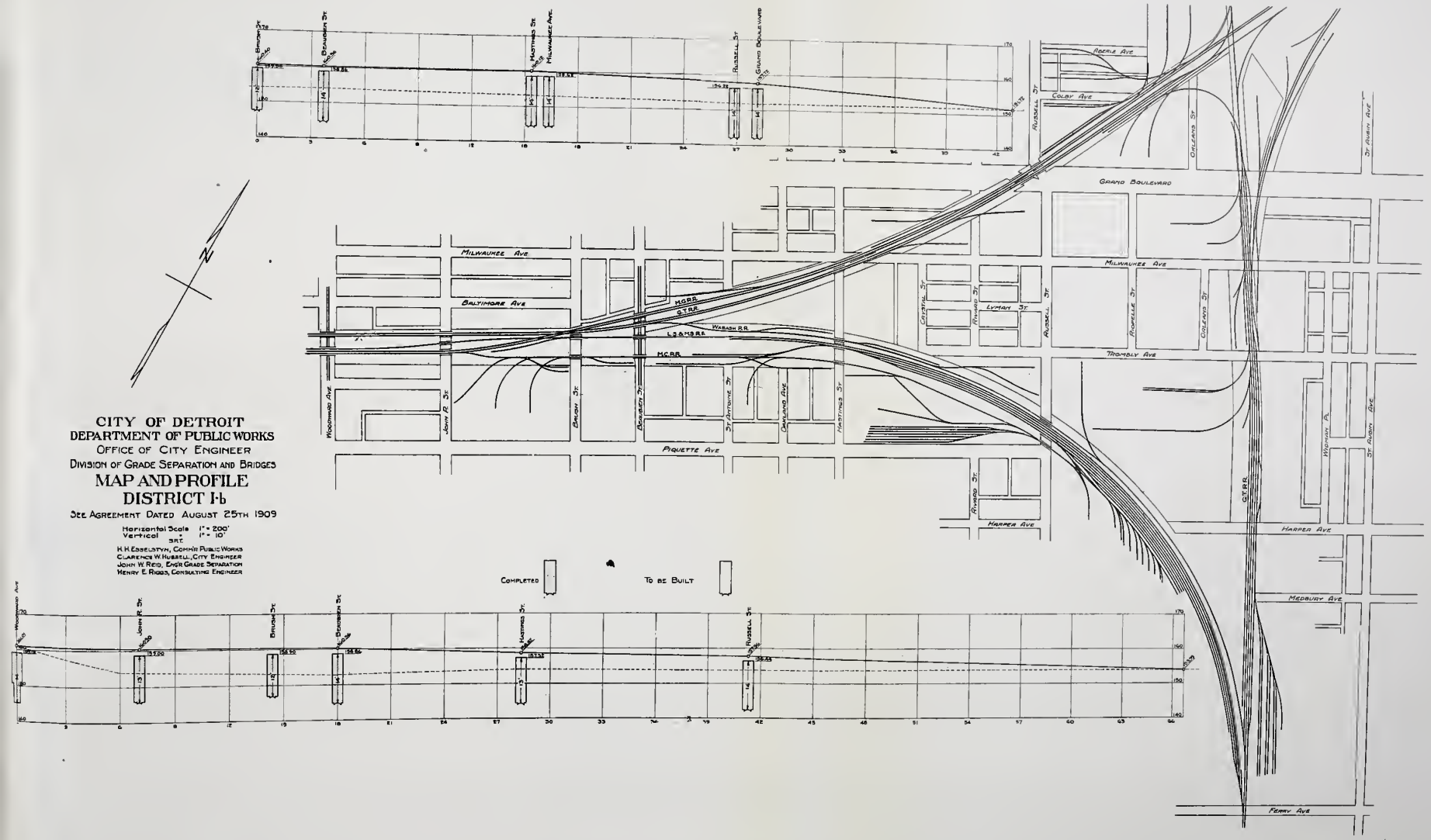


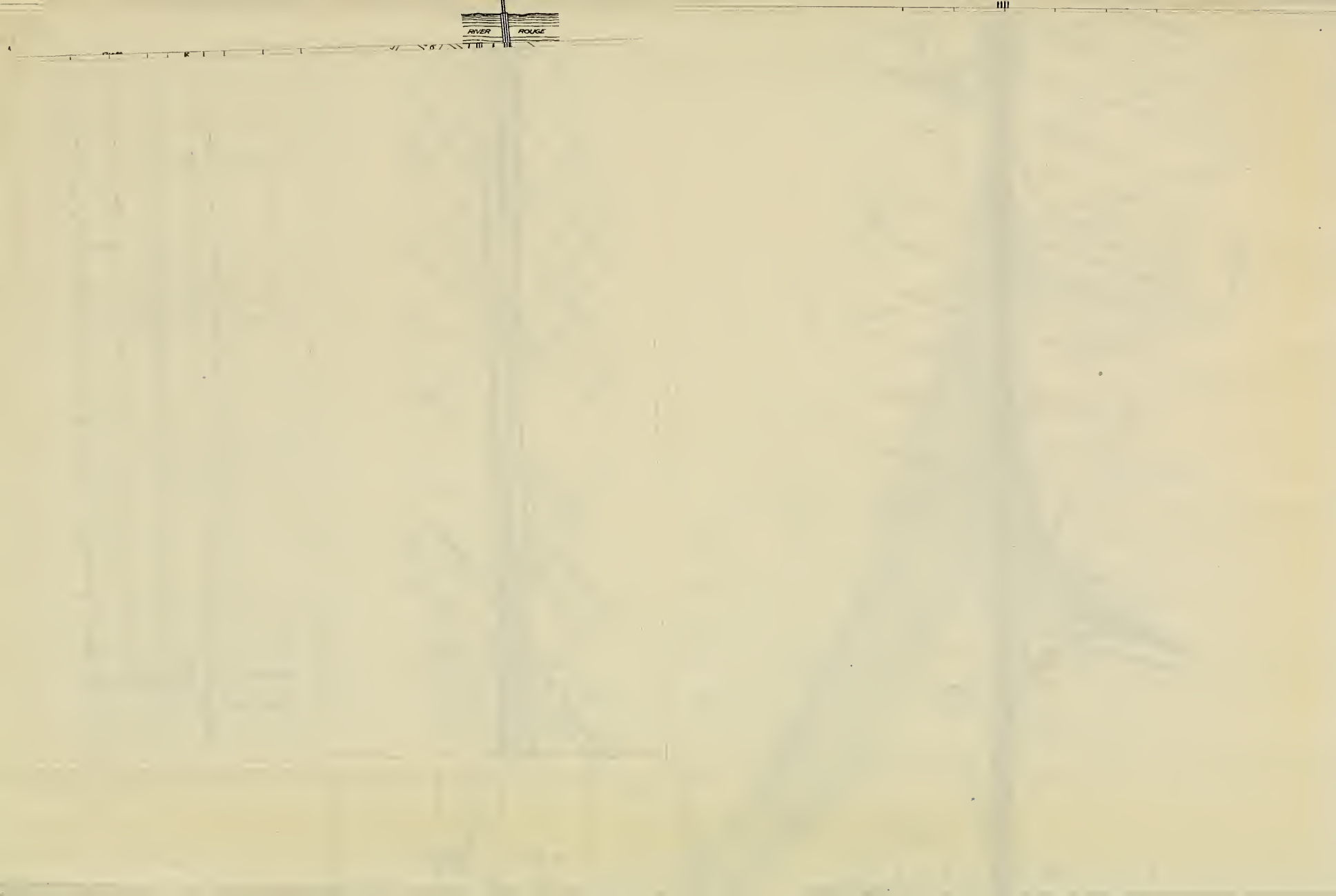
CITY OF DETROIT
DEPARTMENT OF PUBLIC WORKS
OFFICE OF CITY ENGINEER
DIVISION OF GRADE SEPARATION AND BRIDGES

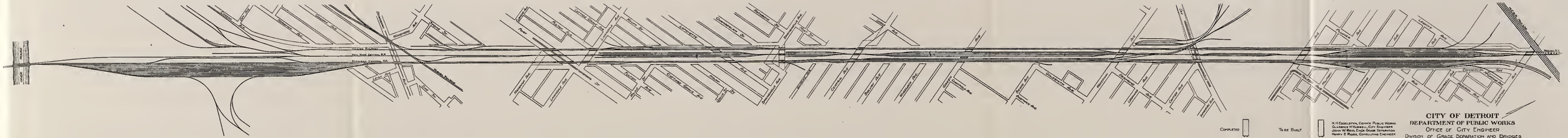
MAP AND PROFILE
DISTRICT I-b

See Agreement Dated August 25th 1909

Horizontal Scale 1" = 200'
Vertical Scale 1" = 10'

H. H. Esselstyn, Comm'r Public Works
Clarence W. Hubbell, City Engineer
John W. Reid, Engr Grade Separation
Henry E. Riggs, Consulting Engineer


RIVER
ROUGE



Completed

To be Built

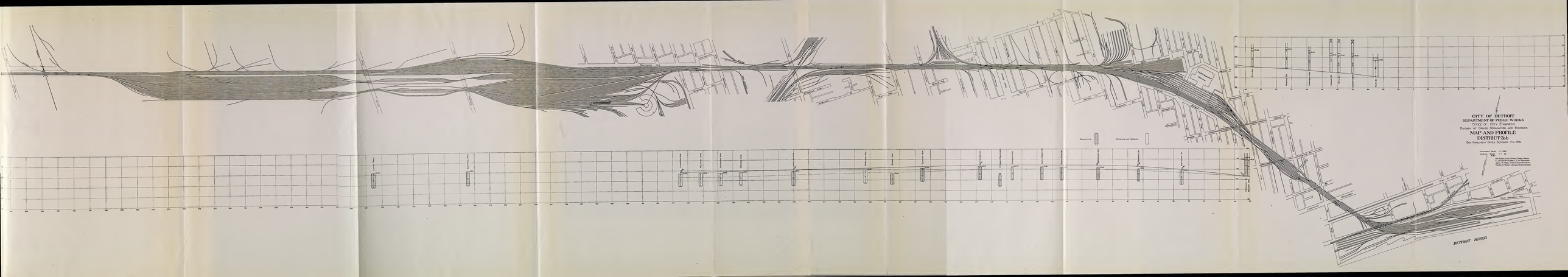
H. H. Eggleston, County Public Works
R. A. Leonard, Mayor, City Supervisor
John W. Reid, Engineer
Henry E. Riggs, Consulting Engineer

CITY OF DETROIT
DEPARTMENT OF PUBLIC WORKS
OFFICE OF CITY ENGINEER
DIVISION OF GRADE SEPARATION AND BRIDGES

MAP AND PROFILE
DISTRICT I-c

See Agreements Dated May 23 1916 and Sept 25 1917

Horizontal Scale 1" = 200'
Vertical Scale 1" = 10'
S.S.T.


CITY OF DETROIT
DEPARTMENT OF PUBLIC WORKS
OFFICE OF CITY ENGINEER
DIVISION OF ENGINEERING IMPROVEMENT DISTRICTS
MAP AND PROFILE
DISTRICT 2sb
SPECIAL ASSESSMENT DISTRICT OCTOBER 17TH 1906
Horizontal Scale 1" = 200'
Vertical Scale 1" = 10'
Commissioners
Commissioner of Streets, Parks & Waters
Commissioner of Sewers, City Engineer
James W. Ross, Chief Clerk Secretary
Harold A. Wilcox, Corporation Counsel
Concrete
Stream not Opened
DETROIT RIVER

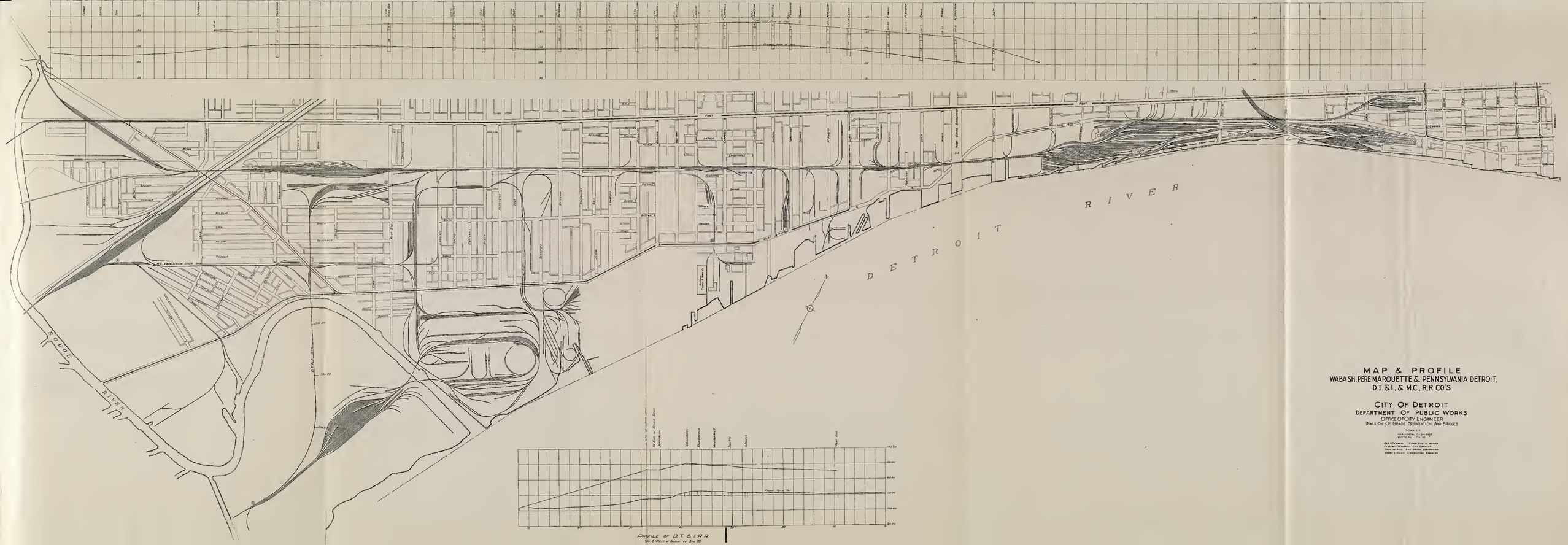
HANCOCK
WARREN
Grosse Chemical Co.
Detroit Cabinet Co.
H. Bartholomew & Son
General Ice Delivery Co
Lumber Yard
H. Thorpe ...d & Cons
The Hoyt Co Art Shop
60'
60'
0.0
143.9
HANCOCK
WARREN

DEQUINDRE STREET GRADE SEPARATION
MAP AND PROFILE - GRAND TRUNK RAILWAY

CITY OF DETROIT
DEPARTMENT OF PUBLIC WORKS
OFFICE OF CITY ENGINEER DIVISION OF GRADE SEPARATION

Scale of:
Horizontal: 1 Inch = 200 Feet
Vertical: 1 Inch = 10 Feet
Published in 1917

Geo. H. Fenkell, Comm'r Public Works
Joseph Van Zuylen, Deputy Comm'r
Daniel Mac Eachron, Assistant
Harry E. Hale, Consulting Engineer



MAP & PROFILE

WABASH, PERE MARQUETTE & PENNSYLVANIA DETROIT, D.T. & I. & M.C., R.R. CO'S

CITY OF DETROIT

DEPARTMENT OF PUBLIC WORKS

OFFICE OF CITY ENGINEER

DIVISION OF GRADE SEPARATION AND BRIDGES

SCALES

HORIZONTAL 1 INCH = 200 FEET

VERTICAL 1 = 10

GEO. H. FERRELL, COMM. PUBLIC WORKS

CLARENCE M. HOWELL, CITY ENGINEER

JOHN W. REID, ENG. GRADE SEPARATION

HENRY E. RUDD, CONSULTING ENGINEER

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